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TRAFFIC ENGINEERING & CONTROL

VOLUME 2 No. 11 MARCH 1961

The only British monthly devoted exclusively to traffic engineering.

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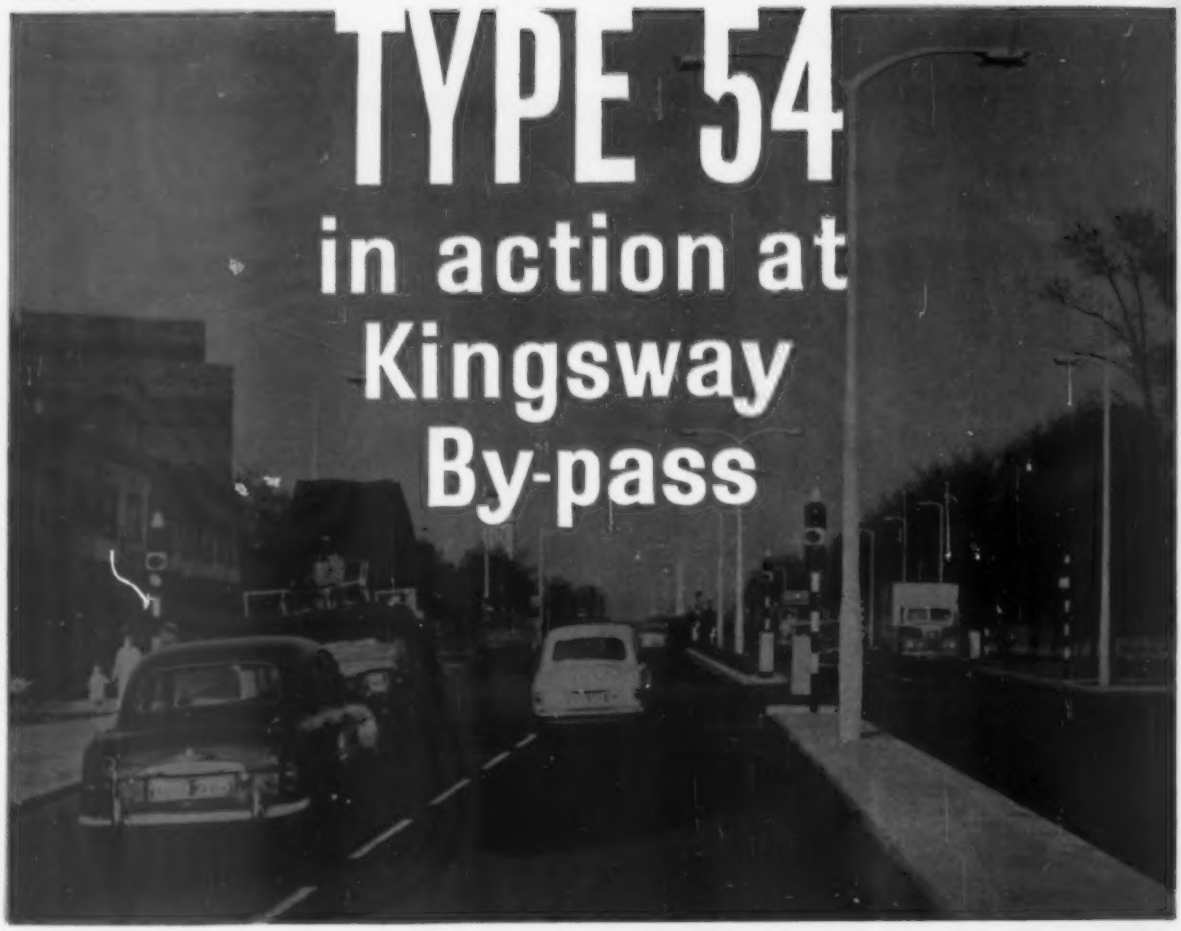
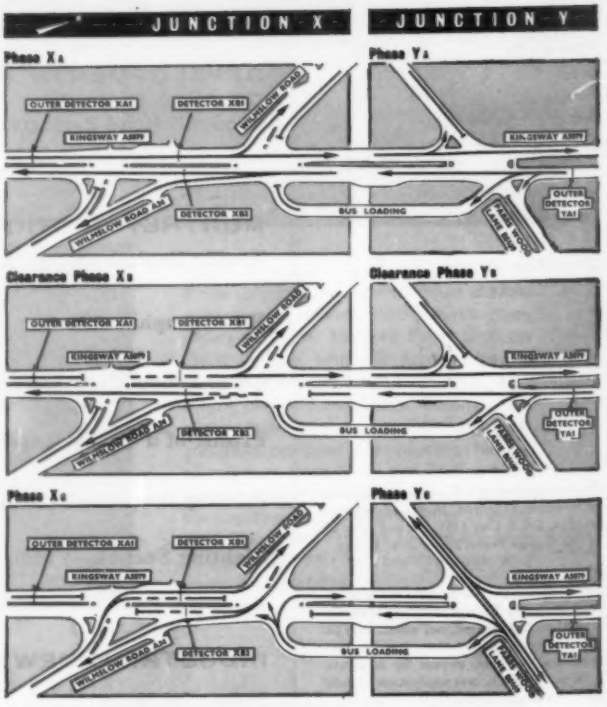
TYPE 54 in action at Kingsway By-pass



This advertisement, first of a series intended to feature the most interesting applications of Type 54 Controllers highlights the important Kingsway - Wilmslow road intersection and approaches, once one of the most congested junctions in the North of England but now a model of good traffic regulation with the factors of safety, speed and priority judiciously assessed, to the impartial benefit of every vehicle, by the Type 54 Controller.



Phase Xa and Phase Ya. *Kingsway traffic has right-of-way. Side road traffic and bus traffic from loading bay is held.*

Clearance Phase Xb. *Kingsway traffic is held at each side of the reservoir but traffic in the reservoir is allowed to flow out. Wilmslow traffic and bus traffic from loading bay is still held.*

Clearance Phase Yb. *Kingsway northbound traffic is allowed to flow. Kingsway southbound traffic is allowed to flow to Wilmslow Road to come under the control signals at that point. Parrs Wood Lane traffic is held.*

Phase Xc. *Kingsway traffic is still held at each side of the reservoir. Traffic from Wilmslow Road can now flow out and then filter left, or enter the reservoir to await the Kingsway phase Xa. Bus traffic from loading bay is released.*

Phase Yc. *Parrs Wood Lane traffic has right-of-way. Kingsway traffic is held.*

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Transport Planning and Land Use

JULY last year, the Minister of Transport announced in the House of Commons the setting up of a long-term study group on roads and traffic. There was more enthusiasm than precision in his presentation of the terms of reference, but at least he gave some encouragement to those who had been advocating not only long-term planning but also the co-ordination of transport planning with land use. Expectation that this would result was further encouraged by the Minister's choice of Mr. C. D. Buchanan for the task. First, because he was transferred from the Ministry of Housing and Local Government, with which the closest liason is essential if there is to be the proper co-ordination between land use and road building, and second, because he is the author of 'Mixed Blessing—The Motor Car in Britain', which is not only a trenchant indictment of this country's failure to seize the opportunity for comprehensive planning in the motor era that presented itself after the war, but also because it is constructive in its criticism and mades a convincing case for doing something before the opportunity is lost. Unfortunately, little has been heard of the study group since, and it might be suspected that its appointment was yet another case of substituting a committee for action.

However, renewed hope that this might not be so came with the announcement of the Parliamentary Secretary to the Ministry of Housing and Local Government, on January 31, that the Ministry was 'beginning' a study of city centre development to see what general guidance might be given. He made the welcome addition that the Minister of Transport was much concerned and the two departments were in close touch and collaborating over the studies to be initiated. This is very welcome, but it comes somewhat late in the day; and it could have been expected that thought would have been given to the formulation of the principles to be followed and standards set for urban renewal earlier, so that, when an easing of the restrictions on capital expenditure became possible, the national and local authorities could go ahead. As it is, much redevelopment may be taking place based on earlier thinking, and guidance some 14 years old, and which takes insufficient account of the needs of the motor age. Now that there is hope that the country is entering a period of extensive urban reconstruction, the opportunity is great but the confusion as to how to make use of it greater, and the greatest need is for guidance based on a reassessment of predictable requirements. A case in point is the current controversy as to whether ring roads or radials are more suitable for coping with the traffic that is generated by urban growth. On the one hand, there is the directive given by the Government in 1947 favouring ring roads, and, on the other, the strong case for reassessment made by Professor W. Fisher Cassie in his paper reprinted in this Journal last month, and Mr. R. M. Hare's article this month. From neither Ministry has an authoritative opinion been forthcoming and, with increased expenditure on urban roads authorized, many authorities are proceeding with plans for ring roads which soon may have inadequate capacity to serve modern traffic needs.

This is not a matter for decision for either Ministry but for both acting in collaboration. In regard to urban areas as a whole, and not only city centres to which the Parliamentary Secretary referred, the responsibilities of the two Ministries are inextricably interwined. Urban traffic does not exist for its own sake: it is generated by the industrial, commercial and social life of a town. It flows from the use that is made of the land and, since with urban renewal that can be controlled, it can be related to the transport needs that would arise from any particular use to which it was put. One influences the other, and intelligent planning can help in obtaining the most economic provision for meeting the desires of each. Land use planning and traffic planning are consequently inseparable. It is therefore, essential that the joint study now announced be made with the greatest sense of urgency. The Ministry of Housing study, and that of the long-term study group at the Ministry of Transport should be closely linked and no unnecessary handicaps imposed by the Treasury on their work, or by either Department in regard to the demarcation of their respective spheres of responsibility, handicaps that are not always absent from inter-departmental activities.

The professional institutions have been a long way in advance of the Ministries in their awareness of the urgency of this problem, as have some of the bolder municipalities, but lack of decision and guidance creates confusion, and inhibits the chances of sensible decisions being taken by elected lay authorities. This then is among the most urgent problems in the field of planning and transport: the determination of both the principles on which urban renewal should proceed, and the standards that should be followed in applying them. If this is not done now, the opportunities for coping with the motor age may well be lost and many of the benefits that it confers not fully reaped.

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Topics of the Month...

DR. R. J. Smeed, Deputy Director of the Road Research Laboratory, has thrown fascinating new light on 'The Traffic Problem in Towns', the subject of the paper he presented to the Manchester Statistical Society last month. Figures given on the estimated ground space required for different modes of travel revealed the transport deadlock that could be reached unless there were an intelligent combination of urban development and the scientific assessment of traffic needs arising from it. For instance, during the peak hour, a journey by one person of one mile requires about a square foot by suburban railway, three square feet by walking, between five and 80 square feet by car, according to the number of passengers and the type and width of road, and from four to ten square feet by bus. After experimenting with a theoretical town, certain conclusions were reached. If these were applied, for example, to the City of London, with its area of one square mile and available road space of only 0.14 square miles and with 335,000 people coming to work daily, an impossible situation was found to develop if all travelled by car. Road space then required would, apart from parking space, amount to over half of the total area, that is 0.65 square miles. Fortunately, such situations cannot arise because congestion, undesirable and economically wasteful as it is, ultimately becomes a deterent to the use of the private car. Dr. Smeed's findings, however, provide a warning as to the direction in which we are moving and the need for reassessment of needs. As he pertinently pointed out, the conclusions obtained from this theoretical exercise need to be examined in the light of further data and experience. Because of his intriguing findings, and the valuable assistance they can give to planning for the future, it is proposed to publish a lengthy summary of his paper in an early issue of this Journal.

Roads for London

FOLLOWING the increase in London's road programme to £10 million a year, the London County Council has established a Roads Committee with Mr. Richard Edmonds, formerly Chairman of the Town Planning Committee, as its Chairman. At the same time, a new traffic engineering division has been set up with a new Deputy Chief Engineer (Roads), Mr. F. M. Fuller, responsible for co-ordinating that division with the improvements division, and the bridges and general works divisions. Difficulty in recruiting the necessary qualified staff is evidenced by the Council's decision to embark upon an extensive advertising campaign to attract them. This in itself is yet further proof of the inadequacy of training facilities for traffic engineers available in this country, a subject frequently aired in these columns. This greater recognition of the importance of traffic engineering in the planning of London's roads programme, stimulated no doubt by the comprehensive origin and destination survey now being planned, is gratifying.

The New Roads for London Exhibition at County Hall makes the most of what is being done and planned, and some of the schemes are described in later pages. It is regrettable, however, that this recognition of the need for the application of the methods and techniques of traffic engineering, based on scientifically collated data, comes so late in the day. It means that had the information on London traffic and the Londoner's travel habits, that is to be collected over the next two years, been available now, London's redevelopment would correspondent with greater certainty to predictable needs. As it is, much must still proceed by guesswork and by piecemeal development. This applies particularly to the development of sites by private developers, as has been emphasized in the case of the Monico site and, but for the public protest of disinterested parties, no comprehensive scheme would have been drawn for Piccadilly Circus. Sir William Holford's interesting tentative plan reveals the difficulty of making provision for adequate road capacity to meet the increase in traffic which such a development would be certain to generate. The diversity of interests concerned, and the absence of any one central authority responsible for planning and traffic makes it difficult for adequate attention to be given to traffic requirements arising from new development. Meanwhile, however, the L.C.C. has at least seen the necessity for liaison between its new Roads Committee and the Town Planning Committee by setting up a joint sub-committee to consider and report on road schemes where there are planning considerations. It is difficult to see where there are not.

Pipelines

THE latest evidence that pipelines are likely to be used increasingly as a modern form of transportation is provided both by the Government's declared intention to give powers to the railways to operate pipelines, and by the introduction of a Parliamentary Private Bill for the construction of a pipeline, suitable for carrying various commodities, from Canvey Island to Cranford together with branch lines. To the extent that pipelines carry traffic that would otherwise travel by road, the more relief they can bring to congestion, and their construction is to be welcomed. It is important, however, that the lines be so planned that their terminals are not so situated as to require a larger measure of concentrated distribution by road in already congested areas. This could be the case, for instance, if, as is proposed, one branch line of this new project terminates in West London and throws a greatly increased volume of traffic on to the roads and thereby detracts from the benefits which the Cromwell Road Extension brought. Before it is too late, the principle should be accepted that pipelines should not be planned without regard to other forms of transport, and that in their planning the whole transport pattern be taken into account. Here is more work for the traffic engineer who should be called into consultation so that data as to the effect of each particular project on traffic can be fully considered and recommendations can be made as to the locating of the terminals to enable them to contribute to the relief of congestion and not to add to it.

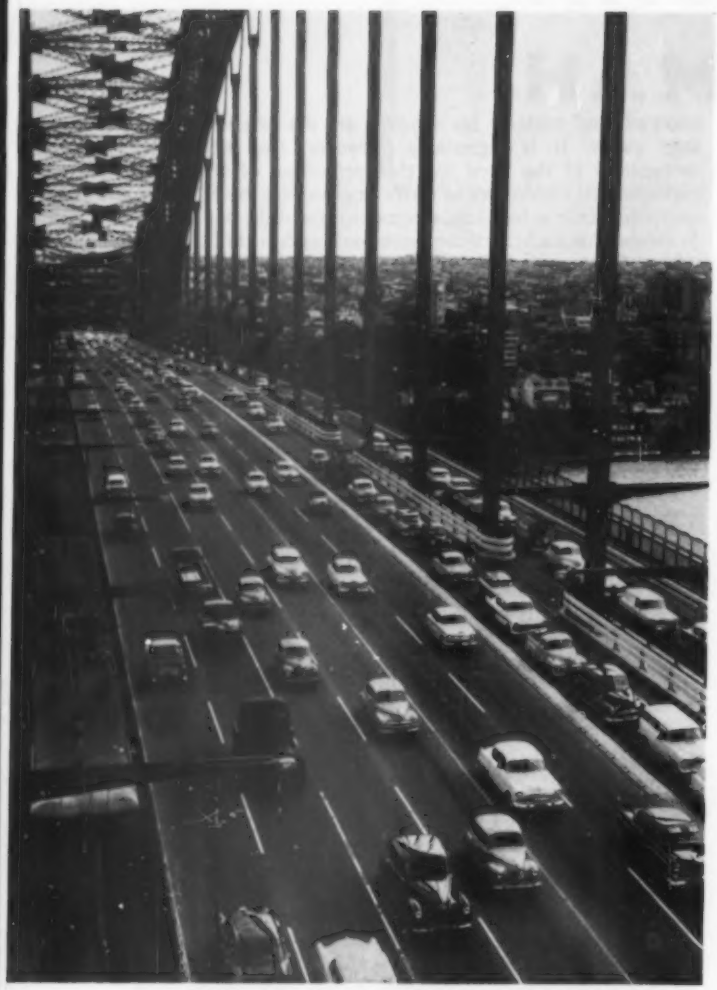

Fig. 1. Morning peak traffic showing four incoming and two out-going lanes.

Tidal Flow SYDNEY HARBOUR BRIDGE

by R. R. COWL

Department of Main Roads,
New South Wales

THE Sydney Harbour Bridge, when opened in March, 1932, consisted of a 57 foot central roadway pavement with two tram tracks on the eastern side and two railway tracks on the western side. With the increase in traffic, it became necessary to mark the six traffic lanes and ultimately introduce a four-two arrangement during peak periods to allocate four lanes to the traffic in the direction of major flow. Even with this tidal flow arrangement, traffic volumes eventually exceeded the bridge capacity resulting in delays to the peak hour traffic. When the tram services north of the harbour were abandoned in June, 1958, and were replaced by buses, it was decided to convert the tramway area for use by road vehicles. As a result of the two additional lanes opened to traffic on July 2, 1959, the delays and congestion due to the inadequacy of the bridge capacity to accommodate the traffic during the peak periods have been eliminated.

When the Sydney Harbour Bridge was opened, the average daily traffic volume was 11,000 vehicles per day. In post-war years, however, there has been a considerable increase in traffic and, in 1958, the average daily traffic volume reached 65,000 vehicles per day. For the twelve-month period following the introduction of the two additional lanes as a result of the tramway conversion, the average daily volume has increased to 73,000 vehicles per day, with peak volumes exceeding 90,000 vehicles per day.

To cater for the increased volume, an unbalanced lane arrangement was introduced on the bridge in 1949, when four of the six lanes were set aside for city-bound traffic during the morning peak period. In 1951, a similar arrangement was introduced to provide for the evening peak. The additional lane for the direction of major flow met the demands for some time but eventually four lanes became inadequate to accommodate the peak hour traffic volumes.

Originally the pavement was marked with a painted centre line but, on the introduction of four-two lane operation, it became essential to mark effectively all six lanes, the kerbside lanes being 10 ft. wide and four inner lanes each 9 ft. 3 in. wide. For more effective delineation of the lanes during the hours of darkness, particularly in relation to the reversible lane arrangement, self-wiping reflectors were installed early in 1952, along the centre line and the two adjacent lane lines, in the interest of public safety. Although the lanes are narrower than is desirable for efficient operation, the calculated possible capacity is 1,520 passenger cars per hour per lane. Allowing for omnibuses and trucks with frequent stoppages on a 6 per cent up-grade, about 5,540 vehs./hour was the calculated maximum number of vehicles that could cross the bridge in one direction using four lanes. Possible capacity is 'the maximum number of vehicles that can pass a given point on a lane or roadway during one hour under the prevailing roadway and traffic conditions.'

However, improvements by channelization on the northern approach in November, 1957, to smooth the flow of traffic approaching the bridge increased the calculated possible capacity for southbound traffic to 5,700 vehs./hour. This was made possible because of the easier movement of buses and heavy trucks from the down-grade merging area in Pacific Highway to the bridge, thereby reducing the effect of the heavy vehicles on the capacity.

Peak Traffic Volumes

Studies of traffic volumes indicate that the bridge reached its possible capacity during peak periods about 1956-57. Because there was no capacity reserve, the general traffic increase consequently spread the duration of the peak, increasing the journey time and the average vehicle delay due to the accumulation of vehicles on the approach roads. For the year ending June 30, 1959, peak hour traffic volumes consistently ranged from 5,600 to 6,200 vehs./hour for the four lanes southbound, with an average of 1,650 vehs./hour for two lanes northbound during the morning peak perod. A similar situation in reverse existed during the evening peak, the northbound traffic ranging from 4,800 to 5,600 vehs./hour, with an average of 2,150 vehs./hour southbound.

Prior to the provision of the additional lanes, the average accumulation of vehicles in the approaches to

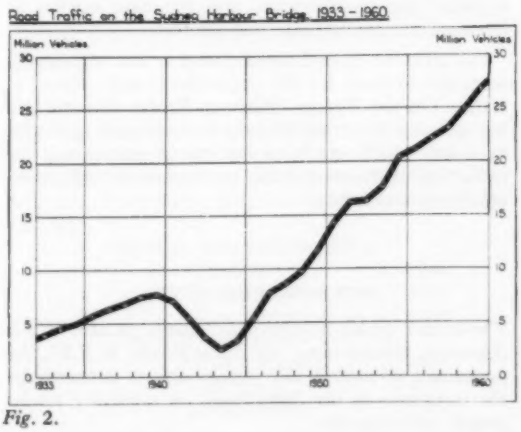

Fig. 2.

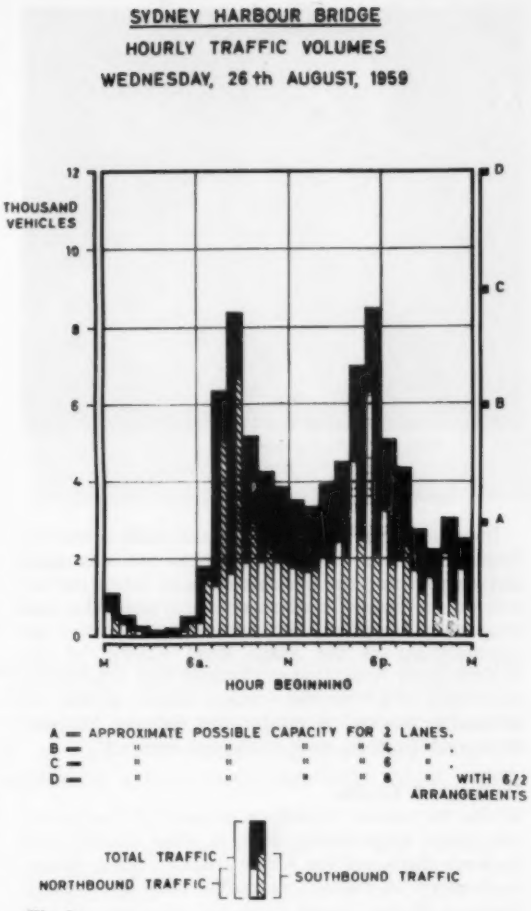

Fig. 3.

the bridge was approximately 600 vehicles in the peak hour. This created delay which increased the journey times during the peak by as much as 300 per cent on the approach roads. The two additional lanes have cleared this excess accumulation and the lost time has been reduced to minor intersection delays, except for a breakdown, accident or other cause not directly attributable to the bridge or approaches. Resulting from the traffic re-arrangement the estimated cumulative saving in journey time, for an equivalent volume of traffic prior to July, 1959, across the Sydney Harbour Bridge, is in the order of 1,350 vehicle hours per day.

The conversion of the tramway area was estimated to add 50 per cent to the capacity for the direction of major flow thus increasing the calculated possible capacity to 8,600 vehs./hour for southbound traffic during the morning peak period. Immediately following the introduction of the two additional lanes, the average Friday morning peak southbound volume during the month of July, 1959, was 6,925 vehs./hour. From random counts present peak hour volumes are now of the following order:

	Northbound	*Southbound*
Morning Peak	1,700 vehs./hour	8,200 vehs./hour
Evening Peak	7,200 vehs./hour	2,000 vehs./hour

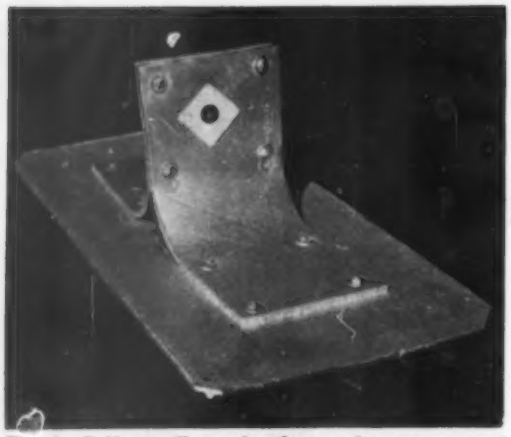

Fig. 4. Rubber traffic marker flaps used to separate and channelize traffic into lanes.

It would appear that the volume of traffic across the Sydney Harbour Bridge in the peak hours is again fast approaching the possible capacity when restriction on the flow of traffic would increase delay and congestion. However, with continued progress in the improvement of the Main Road System in the Metropolitan Area, it is anticipated that a sufficient proportion of the present volumes will be diverted to alternative routes to render the Sydney Harbour Bridge adequate to meet traffic requirements.

Control of Traffic

Whilst the control of traffic is primarily a function of the Police Department there is close co-operation between them and the Department of Main Roads, particularly in relation to traffic using the Sydney Harbour Bridge. Apart from the provision of lane lines and the channelization of the approaches, additional traffic facilities are provided by the Department to relieve congestion.

With the reversible lane arrangement, the use of traffic marker flaps to separate the opposing flows, and channelize traffic into specific lanes, has not only reduced the danger of conflicts, but assisted in maintaining a smooth even flow of traffic necessary to obtain capacity volumes. These traffic marker flaps are fabricated from a piece of rubber conveyor belting as a base, and two pieces of ½ in. rubber strip 6 in. wide placed back to back vertically, painted with aluminium paint. In recent years 2 in. x 2 in. Scotchlite diamonds have been fitted on either side to improve visibility during hours of darkness (Fig. 4). The flaps are placed or removed from a trailer drawn by a tow truck under police escort and, throughout the day, are adjusted for the particular lane arrangement applying to that period. Two crews are employed, one for each of the morning and evening traffic.

With the large increase in motor vehicles using the Sydney Harbour Bridge during post-war years it was considered that a towing service should be provided for the removal of disabled vehicles in order to reduce delay during the peak hour traffic. Consequently, the Sydney Harbour Bridge Tow Truck Service was inaugurated on May 31, 1951, and a free tow truck service is provided during the periods 7 a.m.-9 a.m. and 4.30 p.m.-6.15 p.m. Mondays to Fridays. In July, 1959, this facility was extended to provide a service between the hours 10 a.m. to 6 p.m. on Saturdays, Sundays and public holidays. During the nine years of operation to May 31, 1960, a total of 4,696 disabled vehicles has been removed from the bridge and its approaches during the week-day peak periods. It is significant that over 33 per cent of vehicles that required assistance had run out of petrol.

A series of emergency telephones is installed at 600 to 800 ft. intervals across the Bridge for the use of motorists and police to call for assistance in the event of a breakdown on the bridge at any time. When the towing service operated by the Department of Main Roads is not operating, calls are received at the Toll Office from where arrangements are made for necessary assistance to be provided for a disabled vehicle. In order to secure better co-ordination the Department of Main Roads recently appointed two traffic supervisors to liaise with the police, supervise the tow truck crews, equipment, and maintenance of traffic facilities and to assist in the general supervision of traffic movement. This supervision is given between the hours of 6 a.m. to 7 p.m. on week-days and 10 a.m. to 6 p.m. Saturdays, Sundays and public holidays.

Police Control Devices

Continuous patrol of the bridge throughout the peak periods is maintained by the police who until recently signalled by the emergency telephone for a tow truck immediately a breakdown occurred. However, with the growth in traffic and the extended range of the police patrol, other methods for the detection of breakdowns and the calling of towing facilities have been considered in conjunction with the police. Various suggestions for lookout towers, television cameras and general observation proposals have been considered. Investigations were made in the use of closed circuit television but it is not practical to provide an installation to give adequate coverage to the bridge and its approaches. Finally, consideration was given to the installation of radio telephone equipment to provide instantaneous contact between a base station, the police and tow trucks to expedite the speedy removal of disabled vehicles from the bridge. Equipment was installed in three tow trucks, three police motor cycles and the vehicle of the traffic supervisors and officially came into operation on June 14, 1960. Communication is available between the mobile units and the base station or between one mobile unit and another.

An efficient co-ordinated patrol is the universally accepted method for the supervision and control of traffic. On the Sydney Harbour Bridge this method has proved most satisfactory in maintaining traffic volumes which are high by world standards, the reduction of delays and the movement of traffic with efficiency and safety.

ACKNOWLEDGMENT

The author wishes to express his thanks to Mr. H. M. Sherrard, Commissioner for Main Roads, N.S.W., for permission to publish this article, and to acknowledge the assistance of the Department in supplying photographs and diagrams.

ACCIDENT COMPARISONS AT HALT or STOP JUNCTIONS

by S. J. OLDER, B.Sc.

This study undertaken by the Road Research Laboratory Department of Scientific and Industrial Research compares road accidents at certain junctions with and without HALT or STOP lettering painted on the carriageway in addition to the appropriate road signs.

OBSERVATIONS carried out by the Road Research Laboratory, on the behaviour of drivers at junctions with halt signs, have shown that at sites where the word 'HALT' or 'STOP' was painted on the carriageway, an average of seven per cent more drivers made some effort to conform to the requirements of the sign than at other junctions with only the normal 'HALT—Major road ahead' signs. It has been the practice for some years, in certain areas of this country, for this additional marking to be used and to evaluate the additional safety this may provide. A comparison is made in this paper of the accident records for sites in these areas with similar records for sites in areas where no additional markings are used. The sites compared were those already used to study the effect on drivers of the additional marking.

Sites

Accident records have been obtained for a total of 80 sites, at which behaviour observations had been made, 40 with HALT or STOP road marking and 40 without. They were distributed among counties as follows:

(1) Counties with road marking
- Cheshire — 12 sites
- Warwickshire — 12 sites
- Worcestershire — 16 sites

(2) Counties with no road marking
- Gloucestershire — 10 sites
- Lancashire — 15 sites
- Leicestershire — 15 sites

Both T junctions and crossroads were included in the sample, but no more complicated layouts were covered. Most of the sites were in rural areas but a few, roughly the same proportion for each county, were selected in built-up areas.

Accident Data

Accident details for each site were obtained from the appropriate county police records, and included details of all accidents at the junction for as long a period of time as could be obtained from the records. This period varied from county to county according to the local police practice.

Results

In comparing the two groups of junctions it is necessary to have some form of control and two ways of doing this are shown, both giving a similar result.

In the first method, the accidents to vehicles emerging from the minor road are compared with accidents at the junction involving vehicles other than those from the minor road. This can be done quite simply by comparing the percentages of accidents involving vehicles leaving the minor road.

Table I gives the total accidents for each group of junctions. They have been further classified according to the types of junction—T junction or crossroads—at which they occur and according to whether a vehicle emerging from the minor road with the HALT sign was involved, or was a contributory factor, in the accident or not.

TABLE I
Totals of accidents for the junctions in counties with and without road markings

Type of junction	*Vehicles involved*	*Junctions with road marking*				*Junctions without road marking*				
		Fatal	*Serious and slight*	*All personal-injury*	*Damage-only*	*Fat.*	*Ser.*	*Sli.*	*All personal-injury*	*Damage only*
Crossroads	Emerging		12	12	16	1	4	14	19	10
	Other		50	50	56	2	10	18	30	50
T junctions	Emerging	0	27	27	46	1	6	17	24	25
	Other	2	72	74	105	2	8	20	30	46
All junctions	Emerging	0	39	39	62	2	10	31	43	35
	Other	2	122	124	161	4	18	38	60	96

Table II shows, for all junctions in the two groups, the percentages of personal-injury and damage-only accidents which involved vehicles emerging from the minor road. The percentage of personal-injury accidents is significantly less for the junctions with HALT or STOP on the road than for the others. The significance levels quoted for this and subsequent comparisons allow for between-site variations other than those due to road marking by the methods similar to those described in a paper by J. C. Tanner.[1] There is no difference in the percentage of damage-only accidents for the two groups. This, however, is of little importance since there may well be differences between the counties in the frequency with which damage-only reports are made as there is no legal obligation to make them.

TABLE II
Percentages of accidents involving vehicles emerging from the minor road

	Junctions with road marking %	*Junctions without road marking* %	*Significance level of difference**
Personal-injury accidents	24	42	0.05
Damage-only accidents	28	27	
Percentage of vehicle flow from minor road	12	16	

*Probability of the difference in the percentage of accidents occurring by chance.

The proportions of vehicles entering the junctions from the minor road are also given in Table II. These are very similar for each group of sites and there is, therefore, no reason for thinking that a difference in the amount of minor road traffic can explain the difference in the accident frequency at the two classes of junction. This is borne out by the second method of analysis given later, which uses a measure of traffic flow for comparison purposes.

In Table I, for junctions in counties with road marking, the categories of serious and slight personal-injury accidents have been combined. This was necessary as the Cheshire accident records were only available in this form. If, however, only the Warwickshire and Worcestershire data are used it is possible to make a comparison of the serious and slight accidents for the two types of junction. (Table III).

TABLE III
Percentage of personal-injury accidents involving vehicles emerging from the minor road
(Warwickshire and Worcestershire data only)

	Junctions with road marking %	*Junctions without road marking* %	*Significance level of difference**
Fatal and serious accidents	30	35	—
Slight accidents	11	45	0.001

The same relative differences exist between the percentages of personal-injury accidents involving emerging vehicles for the marked and unmarked junctions at both crossroads and T junctions (Table IV). The absolute sizes of the percentages are smaller for the crossroads, but this is probably because at a T junction the minor road is one out of the three arms at the junction; at crossroads it is one out of four.

TABLE IV
Percentage of personal-injury accidents involving vehicles emerging from the minor road at crossroads and T junctions

	Junctions with road marking %	*Junctions without road marking* %	*Significance level of difference**
Crossroads	19	39	0.10
T junctions	27	44	0.10

*See footnote to Table II.

The second method of comparison of the personal injury accident data is to relate them to the vehicle flow. As was shown in another paper[2], an approximately linear relation is found if accidents per year are plotted against the square root of the product

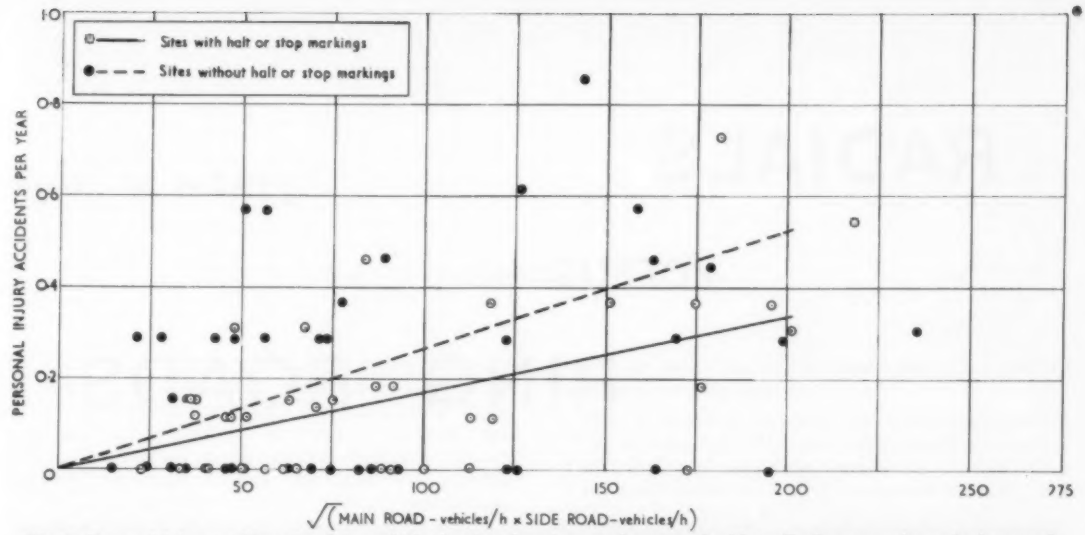

Fig. 1. Personal-injury accidents involving vehicles leaving the minor road compared with traffic flow on major and minor roads

of the minor and major road vehicle flows for each site. The vehicle flows were measured when the behaviour observations were made.

The result is given in Fig. 1, and a definite tendency appears for the accidents to be fewer at sites with 'HALT' or 'STOP' road markings than for the other sites with similar vehicle flows. This is most clearly shown by the two regression lines given on the figure, the difference between their slopes being statistically significant at the 0.05 level. In this comparison, however, no allowance is made for between site variations other than those due to traffic flow or road markings. This allowance can be made by comparing the accidents per year in relation to the traffic flow for groups with approximately the same average flow, as shown in Fig. 2.

Table V gives details of the analysis, the mean values for each group are compared and the difference found to be statistically significant at the 0.10 level.

TABLE V

100 x *personal-injury accidents per year*/$\sqrt{}$ (*Minor road traffic flow* x *major road traffic flow*)

Traffic flow vehicles per hour	*With road marking*	*Without road marking*
0–50	0.20	0.42
50–100	0.16	0.24
100–150	0.11	0.27
150–250	0.24	0.22
Average	0.178	0.288

(*Concluded on page* 665)

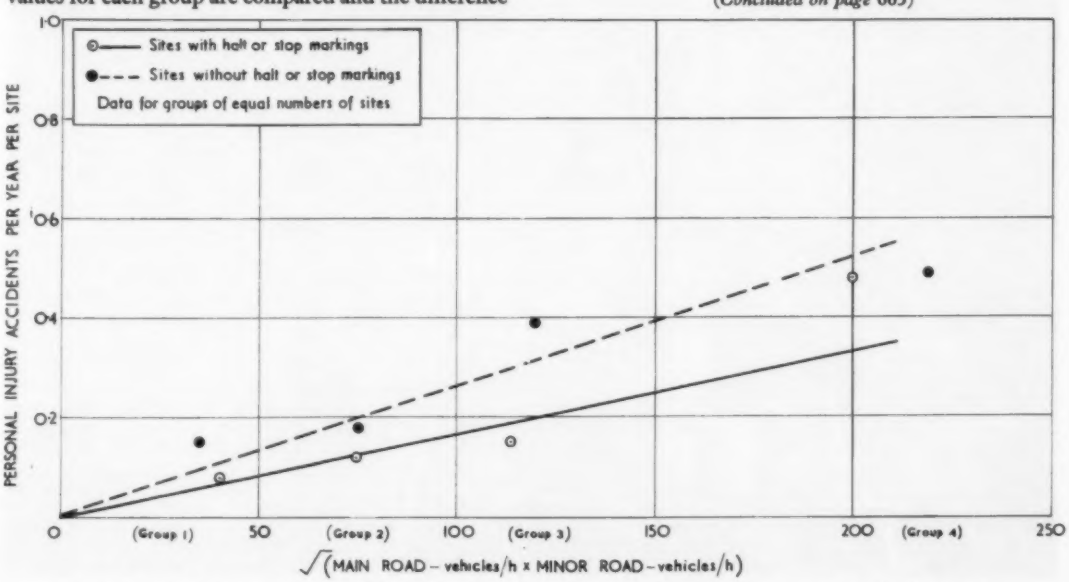

Fig. 2. Personal-injury accidents involving emerging vehicles compared with traffic flow on major and minor roads.

RADIALS *versus* RING ROADS

Fig. 1. A Section of Hollywood Freeway, Los Angeles, a typical example of an American urban motorway.

by R. M. HARE,

Fellow of Balliol College, Oxford

THE subject of this article is the location of new roads in urban areas. Not all cities have the same problems; and, in particular, the problems of large ones are very different from those of medium and small. So, to take a manageable problem, let us imagine that we are debating the future road pattern of a medium sized city, of up to 150,000 population, lying at a distance from major conurbations. Oxford might serve as an example. In such a city, it is to be expected that there will be a substantial amount of through traffic, not needing to stop in the city; but it will seldom be the case that the removal of this traffic will by itself do more than compensate for a few years' growth. The main problem will be that posed by the traffic seeking to go to and from the commercial centre of the city. No solution which fails to deal with this has a hope of success. Therefore, though in such a debate there will be advocates of outer and intermediate ring roads, and though, indeed, such roads may have been, or may be, built, it may come to be thought wiser to attack the main problem first; for until a solution is found for this, we shall not know whether it may require measures which will, without extra expenditure on by-passes and intermediate ring roads, solve the problem of through and inter-suburban traffic as well. It is an expensive business building two roads where one will serve.

Ring Road Fallacies

There will be vocal support, in such a debate, for proposals for an *inner ring road*. Since these inner ring roads were until recently thought of as the text-book solution to urban traffic problems, it is interesting to notice signs that their popularity is on the wane. The reasons are not hard to find. It is not often the case with existing cities that their central areas are bounded by a neat circle. Usually there is no definite boundary to the central area. It will shade off into residential areas, with promontories of business premises and shops going out along the main existing radial roads. This lack of compactness in city centres has the consequence that if we try to draw a neat inner ring road round them, what we shall in fact be doing is either, if we are ruthless, to put our road actually *through* these promontories (often containing buildings of high financial or aesthetic value); or, if we are more faint-hearted, we shall put our road too far out to give convenient access to the middle of the central area, which generates most of the traffic. The result of the latter choice will be that much of the traffic will ignore the new road and continue to congest existing roads. This dilemma is the rock upon which idealistic town planning has foundered in many cities. It is, as we shall see, an avoidable one.

We must remember, also, that city centres are not static in size, but often expanding rapidly to serve a richer and more numerous population. An inner ring road which starts as a relief to the central area may end up as a tourniquet. For here we are faced with a further dilemma: is it to be a properly designed restricted access traffic road; or is it to be, like the roads which it is relieving, a free-for-all town street with full pedestrian and frontage access, shops, frequent intersections, and all the other features which make the existing streets dangerous and congested? If it is sought to make the road a traffic artery pure and simple, it will be objected (apart from the high cost of such a road) that frontage values are being lost, and that important districts are being severed. But if, in acceding to these objections, the planner becomes less exacting in his design requirements, the danger is that the city will end up with a beautiful new shopping street, wider than the old ones, on which the traffic at first moves faster and kills more people than before; later, the new shops will generate new traffic, congestion will return, and the city will have a centre that is bigger and brasher, but no better than before in respect of the defects that traffic engineering seeks to remedy.

Intersection Problems

The *junctions* of the new inner ring road with existing roads present an acute example of this problem of reconciling incompatible requirements. If they are designed to proper standards, especially if they are multi-level, they will take up a great amount of space and lacerate the city centre architecturally. It is, therefore, to be expected that compromises will be forced on the planner; because of the difficulty of overcoming local opposition, he will usually end up with a necklace of roundabouts of inadequate size which very soon become congested. Indeed, if he is sensible he will limit himself from the start to a well co-ordinated system of traffic light intersections. These, though the necessity for them in itself condemns the inner ring road solution, can probably deal with as much traffic as can any type of intersection which is a practicable proposition in a city centre. Far better to choose a road pattern which keeps junctions to a minimum and keeps them away from the central area.

Another trouble is that, for nearly all the traffic with which it deals, the inner ring road relies (at any rate in nearly all British plans) on existing radials as

Fig. 2. Application of radial expressway system to an existing city. The total length of the expressway is much less than that of an outer ring road surrounding the built-up area.

feeders. The traffic has to come down these before it is diverted on to the new road; and they are very seldom adequate for it. Indeed, traffic dangers and delays are often almost as great on the old radials as they are in the centre. If, therefore, nothing is done but to build an inner ring road, matters may become much worse. The new road may encourage new central development which generates increased traffic, all of which has to force its way down the old radials. Then, either the old radials will have to be widened (often an unsatisfactory and costly job); or they will have to be replaced. But in the latter case, as we shall see, the inner ring road itself becomes superfluous, since its job was to link up the existing radials; the new ones can usually be led directly into one another outside the city centre without the need for such links.

The theoretical fault which is the cause of these practical troubles is connected with the geometry of ring roads. The preponderant traffic flows are to and from the centre (i.e. radial); and nearly all the rest of the traffic can, and at the moment does, use radial routes. The existing road layout of most of our cities is not usually an accident; it consists of radial roads and little else, because that is the kind of layout which best serves the traffic. The main traffic flows being radial, it is natural that the roads which have been found useful are radial too. To serve the same purposes better, what is needed is not a quite different kind of layout based on circles, but the replacement of these sub-standard radials by new roads of modern design. As was pointed out long ago by L. B. Escritt, the circle, which is at right-angles to all the radii, is likely to be the least useful route for a road; for the least useful route is that which lies at right-angles to the main traffic flows, which are radial.

Another effect of the same geometrical fault of ring roads is that traffic is caused to travel further than it need. It is true that, because of their small size, this applies less to inner ring roads than to outer; and also that by building new ring roads to first class standards, and leaving the existing roads as they are, or even putting restrictions on them and thus imposing delays, such traffic as can use the new roads may be caused to do so. But if we are trying to get the best road layout, would it not be better to start by asking whether it is feasible to build roads which go as straight as possible where most of the traffic is bound for?

The main problem which has to be solved is that of getting drivers to their destinations, or to car-parks near them, but in a less chaotic way than is done by existing roads in most cities. We have to retain the convenience of the motor car, but to remove the causes of danger and delay, of which the two chief ones are intersections and pedestrian access to roads.

The key to the solution of the problem can be seen if we take an origin and destination survey table for a typical city of the size with which this article deals (Oxford for example) and, considering each of the elements of the traffic in turn, ask 'Does it have to be carried through the centre?' The answer will be in each case, 'No'. Some of the traffic (in the case of most cities a great deal of it) has to be carried to the centre, and other elements have to be carried past the centre. None needs to be carried through the centre with the exception of some public transport and some vehicles delivering goods.

In moderate-sized towns, it is fairly obvious that what are required are, to coin a slogan, *termini for the terminating traffic*. This traffic, the traffic going to the centre, does not need any kind of continuing road at all. The inner ring road seeks to provide a facility which is quite unnecessary. It is a means of driving from one part of the centre to another, which, in cities of the size being considered, hardly anybody wants to do, because it is quicker to walk. There is no need to join up the car parks in the central area to each other, as inner ring roads do. The car parks need access from the outside world.

Suppose, therefore, that we start with the aim of providing for the main traffic flows, which are radial—remembering that, provided that the radials are somehow joined together into a complete system of radials, replacing the present one, they will serve not only the radial purpose but also all the other subsidiary purposes, as do the old radials. This should become clear from Fig. 2. It shows a new system of radials replacing an obsolete one, with the new points of junction shifted away from the old centre. The new radials, which are in the form of tangents to the city centre, start from the open country outside the city (where they link up with existing radials or, eventually, new motorways), and, penetrating deep into the built-up area, though not into the centre itself, connect with each other at points near, but not in, the centre.

Most cities are not so continuously built up as to make such an aim impossible of realization. There will be semi-derelict land alongside railways; unused floodlands; areas due for redevelopment; undeveloped land between ribbon-developed existing radials, and so on. Oxford, whose planning problem has been thought to be peculiarly intractable, provides examples of all these opportunities; the problem has been thought intractable because what planners were looking for were routes for inner ring roads—and to find these is indeed an intractable problem. If the planner is trying, not to drive a strait-jacket ring road all round the centre, but to reach the edge of the centre at some point or other, his task is enormously

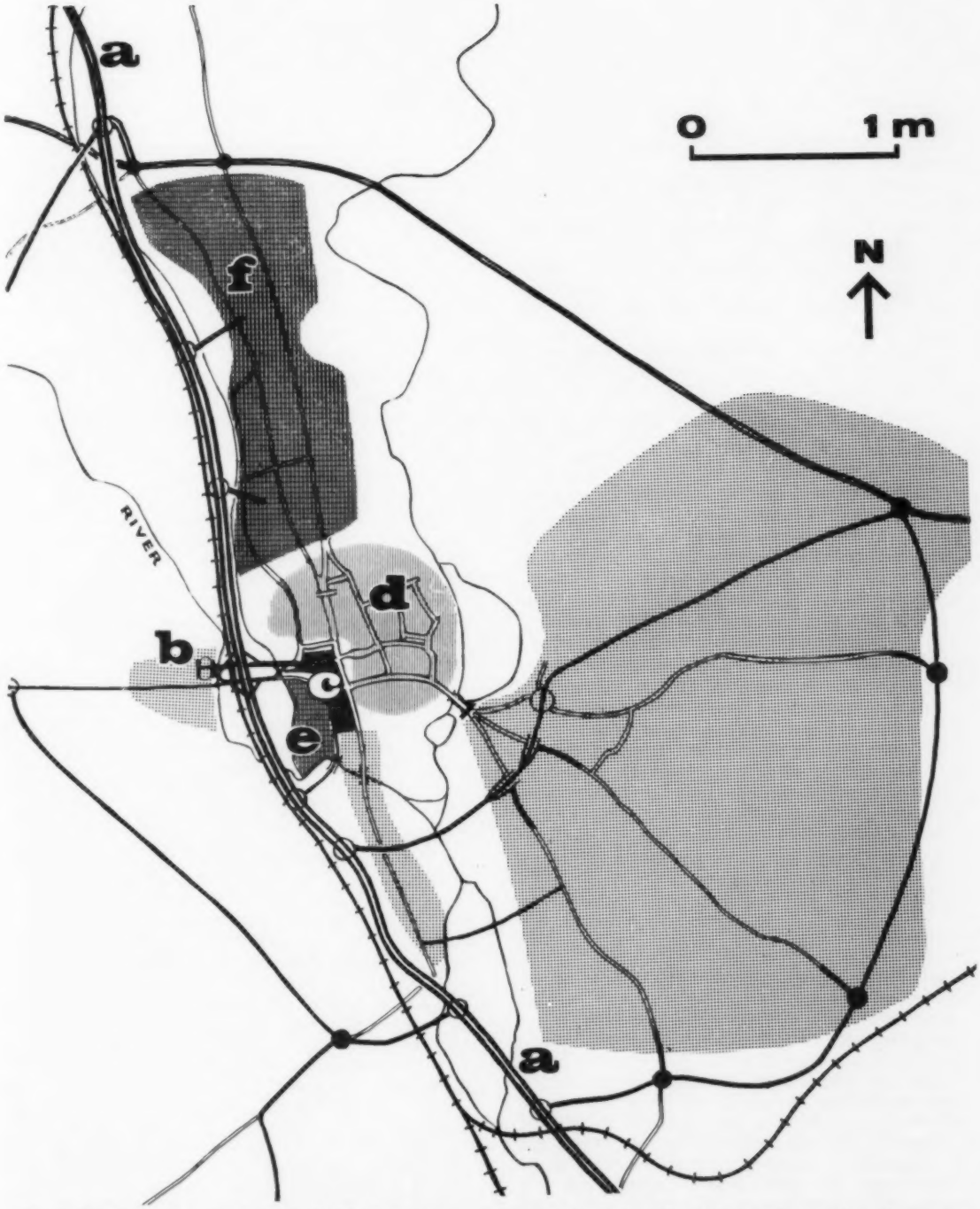

Fig. 3. The Townmaker plan for Oxford. A 'spine' motorway **a** *along the line of the railway gives quick access from the country and the suburbs* **b** *to a road-rail transport station and, via an access loop with car parks attached, to the city centre* **c**. *The designers advocate restrictions on traffic in the University area* **d** *and in the city centre which are areas of pedestrian precinct with separation of levels;* **e** *and* **f** *are suburbs considered suitable for immediate and later redevelopment. The outer by-passes are already in existence or under construction.*

simplified. Many cities have at least one side (e.g. that towards the railway) where areas of low property values lie quite close to the city centre.

If the traffic is thus brought to the edge of the centre, it should then be a manageable proposition to connect up the new radial road system (which should be built to the very highest standards) to car parks as conveniently situated as possible in relation to the main traffic generators in the central area.

It is most important to realize that there is no need for the system of radial expressways itself to penetrate the central area. To do this would involve driving wide routes, probably with complicated junctions, through valuable property.

Nor should the tempting alternative be adopted of forcing vehicles to come off the new radials on to the old streets for the last bit of their journey to the car parks; this would defeat the whole object of the exercise. What are required are roads of a wholly different character from the radial expressways themselves, having nothing in common with them but their safety.

It is worth noticing here that a common feature of existing road layouts, often condemned, has in fact a sound economic basis. In districts of high land value near the centres of cities, the roads are usually narrower than those further out. True, the whole system often needs replacing; but, when we do this, we find ourselves subject to the same economic constraints, and perhaps ought to learn a lesson from history. Because a fast road is expensive, we should be content with slow ones. An ill-designed road which suddenly contracts will be the cause of congestion, especially if it has many intersections; but if intersections are avoided, then, provided that a low design speed is deliberately accepted, quite a narrow route can accommodate a surprising amount of traffic without actual congestion.

Flexibility for the Planner

The roads from the expressway to the car parks should be in the form of quite narrow access ramps or slip roads—extensions of the ramps of the car parks themselves. Though narrow, such ramps will not create any more of a bottleneck than the entrances to the car parks which will be of equal width.

Such a system of radial expressways, access ramps and car parks gives the maximum possible flexibility to the planner. He can put his car parks wherever the land is cheapest in the centre, provided that there are thin lines of access to them from outside the central area. Once the design speed is lowered, these modest roads can insinuate themselves into the centre without damage; they will have no intersections and no pedestrians, and in this respect be like the expressways; but the bogey of huge new urban motorways with complex junctions slashing through ancient city centres vanishes.

The low design speed on these ramps can be compensated for by a high speed on the radial expressways themselves. Here, outside the area of high land values, the traffic engineer can have scope to design his junctions (as few as possible) on an ample scale. The driver coming to the centre will have a clear run to its edge, followed by a relatively slow, but short, smooth and safe journey into a car park. The driver who is going not to the centre but past it (and this includes all the traffic for which it is the custom to build by-passes) will have a quick journey all the way.

A limited number of junctions with existing roads can be permitted outside the edge of the centre, for vehicles which have to enter the central streets. These include some public service and some goods vehicles. But everything should be done to discourage the private motorist from following their example. If the only way he can get into the car parks is by means of the access ramps described above, he will probably need no incentive to keep off the old streets altogether; it will be quicker to drive straight to the car park than to enter the existing street system and look for a place to park where he can escape the arm of the law. If a further incentive is needed, the traffic lights inside the central area should deliberately be phased in order to favour the pedestrian. Once the bulk of the traffic is cleared away from central streets by these means, it will become possible to create, within the centre, areas of real 'precinct', with pedestrian streets and all the other good things that the advocates of inner ring roads often promise us.

The only streets in the central area that must be left open to vehicles are those needed for delivery of goods, public service vehicles on town services, and a greatly reduced amount of private traffic. Perhaps it will be possible to widen the pavements (sidewalks) even in those streets which have to remain open to traffic, and to provide in these widened pavements bays for loading and for bus stops where necessary. Back loading to shops should of course be provided wherever possible as development proceeds. Bus stations (for country services and coaches) will have their separate access ways to the expressways, as at the Port Authority Terminal in Manhattan. As redevelopment goes on, it may be possible to establish different levels for pedestrians and vehicles, as in several well known recent schemes; this is clearly the ideal final solution.

The only planning scheme known to the writer in which the principles proposed in this article have been applied to a whole existing city in this country, is the advanced and far-sighted but perfectly practicable scheme of Townmaker Ltd. for Oxford. It was described in *Architect's Journal* for August 4, 1960 (Fig. 3).

Conclusion

To sum up the advantages of this way of renovating the road system of a city: it dispenses with wide new roads carving all round, or in practice through, the city centre; above all, it dispenses with major junctions in the city centre; it gives the planner the utmost possible flexibility in choosing routes for access to his car parks, and sites for the car parks themselves; and at the same time it gives all the elements in the traffic the quickest possible routes to where they want to go. If such a system cannot revive our allegedly wilting city centres, it would seem that nothing can.

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Acknowledgment is made to Townmaker Ltd. for permission to reproduce Fig. 3.

American Report

from Burton W. Marsh and William L. Carson,
American Automobile Association

GAINS FROM CHANNELIZATION

Fig. 1 Intersection, Austin, Texas, showing how channelizing islands separate both left and right turning vehicles from through traffic.

EXPERIENCES of United States communities with channelizing islands have shown that these control devices can be very valuable in effecting safe and orderly vehicle movements at intersections. Their possible use and value are increasingly considered in the planning of new intersections, as well as in the improvement of traffic conditions at existing ones. Channelization often requires little expenditure, yet may produce significant economic benefits by reducing traffic delays and accidents.

By definition, a channelizing island is a type of traffic island located in a roadway to confine specific movements of traffic to definite channels. Channelizing islands normally are located at or within intersections. Another type of traffic island, the divisional island, is used to separate traffic streams between intersections. Either type of traffic island may serve also as a pedestrian island, by providing a safe refuge or vehicle loading place for persons afoot.

Channelizing islands are used chiefly at urban and suburban intersections, where the approach speeds of vehicles are relatively low. However, and as will be noted later, they have also been employed effectively in rural locations. Benefits gained from channelization are usually greatest at those intersections which have a large or odd shaped manoeuvring area, streets meeting at irregular angles, a high number of turning vehicles, or complex vehicle paths.

When properly designed and applied, channelizing islands can often:

(*a*) Improve the angle or location of merging traffic streams.
(*b*) Separate and expedite particular vehicle movements.
(*c*) Help effect proper vehicle speeds.
(*d*) Provide a defined waiting area for vehicles intending to make a certain manoeuvre, generally (in U.S.) a left turn
(*e*) Prevent unorthodox and unlawful vehicle movements.
(*f*) Offer a good location for the placement of traffic control signals and signs.

Design Principles and Features

Islands should simplify traffic movement patterns, not complicate them. Channelizing islands should be designed, therefore, so as to make the correct vehicle path seem the most natural path to follow. Where vehicle paths must cross, the island design pattern should, in general, produce substantially right-angle crossings; where merging is to take place, vehicle paths should parallel each other in advance of the merging area, which should be as long as possible. To the extent feasible, island design should avoid confronting the driver with important decisions too close together.

Detailed design features for channelizing islands depend considerably upon the characteristics of the intersection, and of the traffic using it. Raised islands with a kerb perimeter, with an interior area filled with concrete or soil, are usually required when it is especially important that vehicles do not infringe upon the island, or where traffic speeds are comparatively high. In many locations, however, islands can be adequately delineated by 'jiggle' bars, traffic buttons, or paint. The island area should always be clearly marked and readily evident to motorists.

The proper shape and size of an island will be affected by intersection features, type of traffic movements to be controlled, dimensions of vehicles and other factors. It is usually best to have a minimum number of islands within a given intersection in order to avoid confusing the motorist. When island treatment is being applied to an existing intersection, it is often desirable to try out the proposed island plan with temporary traffic cones, stanchions, barrels or even sand bags prior to permanent island construction. During this test period, traffic observations can be made to determine if any modification is needed in the island layout.

It is extremely important that drivers approaching a traffic island receive adequate advance warning of the island's presence, and a clear indication of the particular action required on their part. Proper treatment of approaches to islands may require the installation of signs, reflectors, flashing beacons, pavement markings, special lighting, etc., depending on conditions at the site involved. Whatever devices are employed, it is important that they be clearly visible at night as well as during the day and, to the extent feasible, that there be uniformity as to what drivers are to do under similar circumstances at different locations.

Studies conducted by traffic engineers of various States and communities have produced clear indications as to the value of well designed channelizing islands.

Fig. 2. Intersection at Chattanooga, Tennessee, before channelization.

In Austin, Texas (pop. 186,545), extensive channelization of intersections was undertaken in 1958, under the direction of Traffic Engineer Walter H. Klapproth. A study of the accident records for 43 channelized intersections, in the year following their channelization, revealed 20 per cent fewer collisions than the average for the previous three years. Reduction in collisions was as much as 90 per cent for individual intersections. One of the intersections had been the scene of 15, 33, and 19 collisions during 1956, 1957 and 1958, respectively. During 1959, after channelizing islands had been installed, only three collisions occurred at this intersection. Fig. 1 shows one of the Austin intersections at which channelizing islands have been provided.

Fig. 3. After channelization.

At an intersection in a suburb of Richmond, Virginia (pop. 219,958), accidents during a period of 11 months killed four persons, injured 11 others and resulted in $14,300 property damage. A study indicated that a major factor contributing to the accidents was inadequate control of vehicle movements in the large area of the intersections. Three channelizing islands were installed to channelize traffic flow. In the following 11-month period there were no fatal accidents at the intersection, only one accident involved a personal injury, and property damage from accidents dropped 68 per cent to $4,600.

Figs. 2 and 3 show how different types of vehicle movements have been segregated by channelization at an irregular shaped intersection in Chattanooga, Tennessee (pop. 130,009). There was a substantial reduction in accidents after the islands were provided, and after certain changes had been made in traffic signs.

Advantages of Painted Markings

The application of pavement markings greatly improved the safety and orderliness of traffic movements through a T intersection in a residential district of Peoria, Illinois (pop. 103,162). A study of intersection conditions by the City Traffic Engineer indicated that improper manoeuvring by drivers was the principal cause for seven accidents occurring at this location during a 19-month period. To alleviate confusing drivers, and to facilitate traffic flow, a reflectorized channelizing island was painted within the intersection, centre line markings were improved, and modification was made in the traffic control signs. Only one accident occurred at this intersection in the 19 months after these changes had been made, and traffic movement was greatly improved. Total cost of improvements at this intersection was under $100.

During a nine-month period, 12 accidents took place at the intersection of two one-way streets in Detroit, Michigan (pop. 1,670,144). After a channelizing island was provided and certain adjustments were made in the kerb lines of one of the streets, there were only three accidents over the next nine months—a 75 per cent reduction.

In Oregon City, Oregon (pop. 7,996), concrete jiggle bars have been used successfully to effect channelization and to correct a serious accident problem at a four-street intersection of irregular layout. A total of 13 accidents, causing one personal injury and extensive property damage, had occurred over a period of 17 months. After a tear-drop shaped channelizing island was provided through the installation of jiggle bars, there were only seven accidents during the succeeding 17 months. The estimated cost of this improvement, as reported by State Traffic Engineer F. Bruce Crandall, was $175. Channelization has also proved of value at rural intersections. In Illinois, studies by that State's Division of Highways have shown that the application of carefully designed channelizing islands at the junction of certain major rural highways reduced their accident rates by an average of 25 per cent. At one of the Illinois intersections a total of 31 accidents occurred over a period of four years before channelization, and none in the year after this improvement was made.

As a result of this extremely favourable experience, Illinois traffic and highway authorities expect to make increasing use of channelizing islands at existing rural intersections, and to provide such features in many new highways under construction or planned.

Conclusion

Street and highway intersections at grade result in conflicts between traffic flows and, hence, often have a high potential for traffic accidents and delay. Traffic and highway engineers should give careful consideration to the design and control of these locations in order that congestion and safety hazards can be held to a minimum. Experience has shown that channelization is one of the most effective ways of facilitating safe and orderly vehicle movements within and through intersections. Channelizing islands, in particular, have proved to be an excellent means of achieving efficient traffic flow at intersections.

It is important, however, that channelizing islands be applied only after an engineering study of both traffic patterns and of proper island treatment. In many instances, changes will be required for other traffic control devices already installed. Unwarranted, or poorly designed channelization features can cause traffic delays and hazards. Before and after studies at intersections, where channelization is applied, will usually provide valuable indications as to how channelization can be employed at additional intersections most effectively.

Accident Comparisons

(*Concluded from page* 657)

Thus, after making allowance for differences in traffic conditions between sites, the personal-injury accidents involving a vehicle emerging from the minor road for similar traffic flows are 40 per cent less at the sites with road marking.

Conclusions

(1) It has been shown that there are fewer personal-injury accidents involving vehicles leaving the minor road at the sites with HALT or STOP markings on the road surface than at the other sites considered. This reduction is more noticeable in accidents involving slight personal injury than in other categories.

(2) A comparison of these accidents with a measure of vehicle flow gives an average accident rate at sites with road marking 40 per cent less than at those without. Thus, again it is shown that the sites with road marking have fewer accidents.

(3) The differences found in these two comparisons of marked and unmarked sites are statistically significant, the first more so than the second.

Acknowledgments

Thanks are due to the Chief Constables of Cheshire, Gloucestershire, Lancashire, Leicestershire, Warwickshire and Worcestershire for permission to use their accident records and for the assistance given by their staffs in obtaining the information required.

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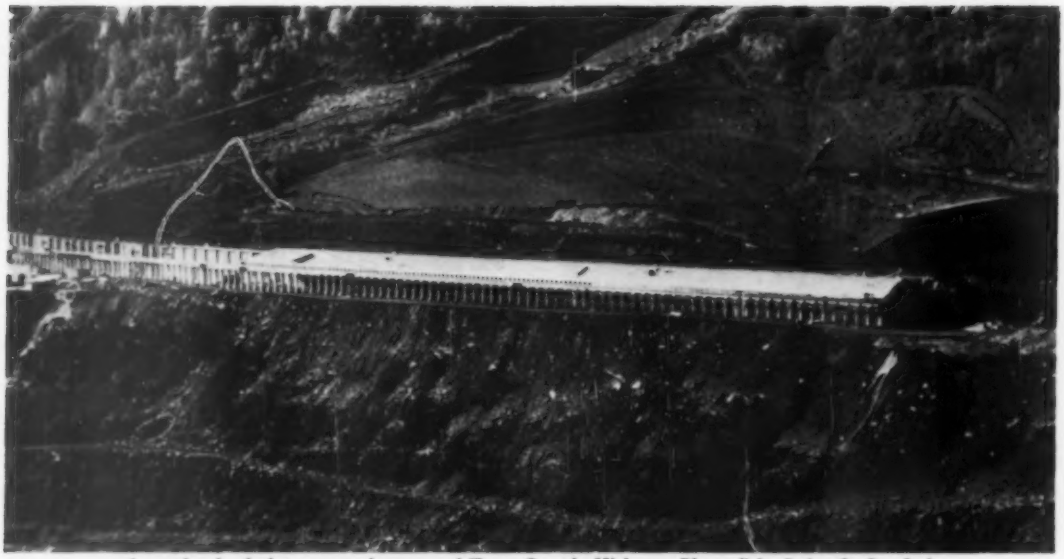
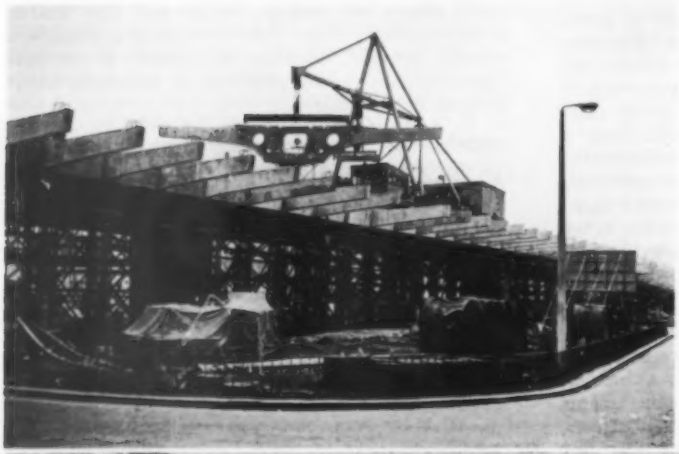


An avalanche shed to protect the proposed Trans-Canada Highway. Photo: John Laing & Son Ltd.



Developments

Left. A concrete cantilever arm is lowered into position on the Hammersmith Flyover, London, which is due to be opened at the end of this year. Below: The Aglio viaduct carries a new section of the Autostrada del Sole across a valley near Florence.

Where the Trans-Canada Highway will run through the Rocky Mountains. Photo: John Laing & Son Ltd.

Illustrated

Right. Toll gates at the end of Sydney Harbour Bridge, showing the tidal flow described in an article on page 652. (Photo: New South Wales Government) Below. A nearly completed section of the Autostrada del Sole between Bologna and Florence.

LONDON'S ROAD PROJECTS

Fig. 1. The temporary viaduct in Hyde Park which carries westbound traffic over the new link road temporarily used only for eastbound traffic coming from Knightsbridge.

SEVERAL development schemes in the London County Council area are at an advanced stage, and many more are on the drawing board. Nearing completion are those at Notting Hill Gate and the Elephant and Castle, while the Hyde Park road scheme has entered its third and final stage, and the Hammersmith Flyover, in connection with the Cromwell Road Extension, is well advanced. Plans have been announced for improving traffic flow at Vauxhall Cross by construction of two roundabouts on different levels, and a tentative scheme for Piccadilly Circus has been prepared for the London County Council by Sir William Holford. In view of the relief that these schemes are planned to bring to London's traffic congestion problem, particulars of four of them are given below.

Main features of the Hyde Park Corner-Marble Arch Scheme are the construction of twin vehicular underpass tunnels running beneath Hyde Park Corner, to take traffic between Knightsbridge and Piccadilly; a completely new and larger roundabout system at Marble Arch, which takes in part of Hyde Park; the reconstruction of the East Carriage Drive in Park Lane, forming a dual carriageway system; and the very much enlarged roundabout at Hyde Park Corner catering for turning traffic and north/south traffic over the top of the underpass. In addition, 16 pedestrian subways are being built. The scheme is estimated to cost £5½ millions and to be completed within 28 months, the main work having started in May 1960.

To enable the construction of the underpass on each side of Hyde Park Corner Underground station, and in Knightsbridge, it was necessary to close Knightsbridge from Hyde Park Corner for about 250 yards, and to divert all the traffic normally using this road into South Carriage Drive, Hyde Park, by means of a temporary link road. To prevent westbound traffic in the South Carriage Drive from crossing the traffic diverted from Knightsbridge at ground level, a temporary viaduct has been constructed in the South Carriage Drive to allow westbound park traffic to pass over the Knightsbridge traffic. The viaduct is of prefabricated steel and has a total length of 946 ft. and provides a 20 ft. wide roadway with a timber deck having a non-skid surface (Fig. 1.)

To reduce interference of pedestrians with traffic during this diversion, a new pedestrian subway has been constructed at Hyde Park Corner which was completed in the record time of three weeks. It was not included in the original scheme but it may later be converted from its temporary nature into a permanent structure.

Hammersmith Flyover

The purpose of the Hammersmith Flyover, carrying the Great West Road (Cromwell Road Extension) over the road and rail complex at Hammersmith is:

(*a*) To improve the traffic complex on the Great West Road linking London with the West Country.

(*b*) To improve the movement of traffic between the Air Terminal

at Cromwell Road and London Airport.

(*c*) To separate through traffic from local traffic and ease congestion in the heart of Hammersmith, a borough of over 100,000 population.

The necessity for the segregation of traffic at this point is evidenced by the doubling of the number of vehicles passing through this area from 35,000 to 70,000 per hour from July 1956 to July 1960. The flyover will carry through traffic and the roundabout already provided will be freed for local and turning traffic. Design capacity of the two-lane dual carriageway is 3,000 per hour in each direction, which is anticipated to be approximately twice as great as the demand on the basis of present traffic.

The design of the flyover presented special problems: the flow of traffic had to be maintained throughout construction; the effect of its great width compared with its height had to be considered from the aesthetic viewpoint and in relation to its surroundings where it runs very close to a variety of old buildings; other problems were the cramped and congested nature of the site and the need to keep to a minimum the area of land which would become sterile or of limited use.

These problems have been solved by the application of recent developments in engineering techniques and, in particular, the use of prestressed concrete which has enabled the flyover to be designed as a slim superstructure carried on single central columns of modest dimensions; a large proportion of its components are built away from the site in the form of precast units. In designing the flyover the consulting engineers, G. Maunsell and Partners, worked in close association with the Council's Chief Engineer, Mr. Joseph Rawlinson, C.B.E., M.I.C.E., and the Council's Architect, Mr. Hubert Bennett, F.R.I.B.A. The contractors are Marples, Ridgway and Partners Ltd.

Fig. 2. The Hammersmith Flyover under construction as seen from St. Paul's Church tower looking west.

Some of the main constructional features of special interest follow:

The flyover is a prestressed concrete structure arranged in 16 spans, 11 of 140 ft., two of 120 ft., two of 94 ft. 6 in., and one of 74 ft.; this 2,043 ft. length of suspended structure being flanked by approach ramps which increase the overall length to 2,831 ft. It is 61 ft. wide, made up of two 24 ft. carriageways separated by a median strip and with outlying service footways.

The superstructure is to a very large extent formed of precast units which are manufactured away from the cramped areas of the site, and are joined together in their final position to form, in effect, one continuous member. The main structural element is a continuous hollow spine beam 26 ft. wide and varying in depth from 6 ft. 6 in. at midspan to 9 ft. at the supports. It is formed of beam segments 8 ft. 6 in. in length which alternate with 12 in. thick transverse cantilever units. The joints between these precast units are of fine concrete 3 in. thick, so that together the units make up a 10 ft. module. The units are prestressed together by longitudinal cables of 1¼ in. diameter which pass through the hollow spine beam in four clusters, one cluster on each side of each inner web.

The reinforced concrete cantilever units serve a dual purpose; they act as diaphrams for the spine beam, and their outer arms support the precast reinforced concrete slabs 8 in. thick, which form the outlying sections of the carriageways. The roadway slabs are made continuous by overlapping their projecting reinforcing steel and placing *in situ* concrete joints.

The cantilever units, shaped like inverted coat-hangers, are 12 in. thick and 59 ft. long and have a maximum weight of 15 tons. They vary in depth from midspan to the supports, matching the neighbouring beam segments. The arms which protrude on either side are tapered in depth, and these repeat along the entire superstructure.

Each cantilever arm is of heavily reinforced section. In all there are 202 beam segments and 202 cantilever units.

Each column, which is tapered and hollow, is built on the site and is connected to the spine beam by vertical prestressing bars. Each is built on top of two roller bearings placed on the concrete foundation. This arrangement allows the flyover with its columns to move longitudinally under temperature changes like a long narrow table on a series of legs each with double castors. These roller bearings, of a special type developed in Germany, carry a direct load of nearly 1,000 tons.

The beam segments which are placed over the columns are prestressed to them by means of 24 Lee-McCall high tensile bars of 1¼ in. diameter. These bars pass right down the walls of the columns inside ducts with their lower anchorages cast into the column foot. The bars are stressed from the top, and

Fig. 3. View of western end of the Hammersmith Flyover showing the columns and the arms of the cantilever units.

besides stitching the beam segment to the column, they also provide sufficient stress for the columns to resist both longitudinal and lateral bending. These particular beam segments are further stressed by six similar bars passing transversely in ducts through the top flange. The purpose of these is to provide adequate strength for the transference of the shear carried by the outer webs of the spine beam, transversely to the columns.

Prestressing

The longitudinal prestressing of the spine beam is provided by 1¼ in. diameter stranded cables using the Gifford-Udall system. Across any section of the spine beam the cables are arranged basically in four clusters of 16, one cluster passing on either side of, and immediately adjacent to, each internal web. At midspan, where the cables are at the maximum eccentricity from the neutral axis of the spine beam, each cluster passes through 10 in. diameter ducts within the bottom flange.

In order to avoid massive anchor blocks and excessive concentration of anchorages, and also to facilitate the construction sequence, the cables are arranged longitudinally in overlapping groups, on a similar principle to staggered lap lengths in reinforcing steel. Each group passes through two successive spans being anchored at both ends in the top flanges of beam segments on the far side of the extreme columns of the particular pair of spans affected.

Safety Fencing and De-Icing

As the flyover runs over crowded thoroughfares, it was imperative that the safety fencing should be strong enough to prevent any vehicle from running off the flyover when out of control, which has been achieved by adopting a design developed in Stockholm which has been subject to full scale tests in which the fencings successfully stopped a bus, loaded with concrete blocks as ballast, travelling at 30 miles per hour head on into the fence.

To prevent icing on the carriageways, the road surface of the entire flyover can be electrically heated by means of cables embedded in the surfacing. Automatic controls ensure that the system is brought into operation only when conditions of both temperature and humidity are such that ice can form. The research, design and specification of the necessary equipment have been undertaken by the Road Research Laboratory.

After 11 months work, four of the 16 spans have been erected and are ready for road works and two of them have been freed from their temporary supports. The construction work is up to schedule and the flyover is due to be opened for traffic by the end of 1961.

PICCADILLY CIRCUS

From the traffic point of view, the interesting feature of the Piccadilly Circus scheme, prepared by Sir William Holford, is the segregation of pedestrians and traffic, except between Regent Street and the centre island on which Eros is still to stand, though re-sited and at a higher level. Escalators are to be provided from street level to enable pedestrians to reach a pavilion, which constitutes the main feature of the scheme. Constructed on approximately the same site as the present London Pavilion, it would bridge the traffic road which now runs in front of it and be further connected with both the Monico and Trocadero sites, on the latter of which it is proposed a hotel be constructed. Provision is made for roof parking of 300 cars on the redeveloped Monico site, but these would not be visible from street level, as they would be screened by the band of advertising above shop windows. Access to the roof

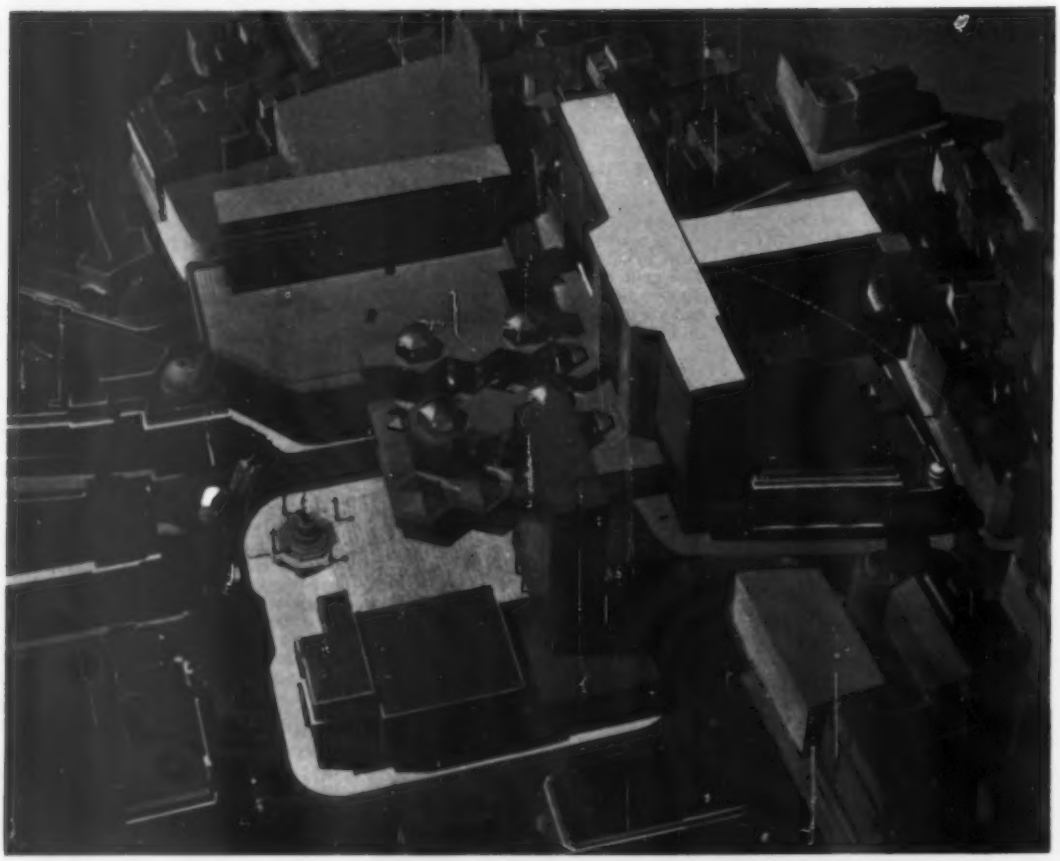


Fig. 4. Aerial view of the model of Sir William Holford's tentative scheme for Piccadilly Circus. Eros resited and raised above a flower shop can be seen on the left with the pavilion to its right linked to the new buildings on the Monico site with provision for car parking on the proposed new construction there. The tall building to the right is that proposed for the Trocadero site and is a hotel.

carpark would be by way of ramps on the northern side of Denman Street and by bridges over the street itself. Looking further into the future, it is suggested that the Criterion site be redeveloped as far as Lower Regent Street, and the present road running in front of it be closed and traffic diverted to a re-developed road behind it.

Both the L.C.C., and Sir William Holford, stress the tentative nature of these suggestions for the planned re-development of the Piccadilly Circus area, as they have yet to be considered in their various aspects by the very large number of developers and others concerned.

VAUXHALL CROSS

The Vauxhall Cross intersection is one of the busiest and most complex in London south of the river. Six main roads meet there but one way working reduces the effective number to five. Therefore, provision must be made for 20 traffic streams to carry the 6,500 vehicles an hour that pass through the intersection.

Space available is severely restricted by the narrowness of the area lying between the river and the railway viaduct carrying the main lines from Waterloo Station. Since it is doubtful whether a single roundabout, however large, would be adequate for more than a few years, it is evident that any long-term solution of the traffic problem must provide for traffic movement at two levels. The combination of a flyover or underpass and roundabout was considered inadequate as the flyover or underpass would take only two of the 20 streams and could not provide for

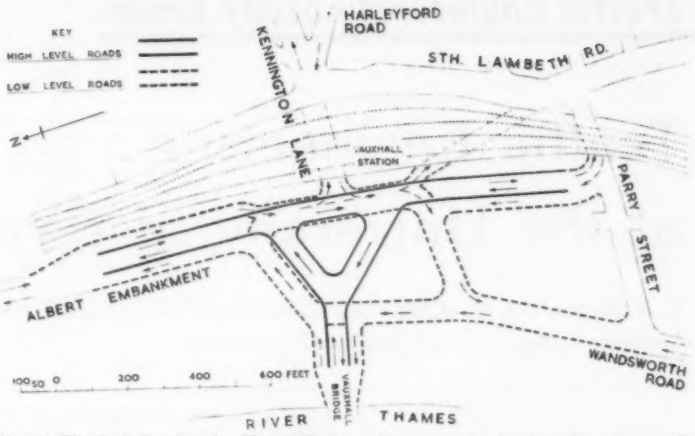


Fig. 5. The L.C.C. plan for Vauxhall Cross improvement showing the two roundabouts at different levels.

turning traffic to and from Vauxhall Bridge. After considering a number of possibilities, it was decided that the best solution would be the construction of a small triangular roundabout at about the same level as the railway viaduct above a larger five-sided surface roundabout. The upper roundabout will deal with traffic between any two of the three roads Vauxhall Bridge, Albert Embankment and South Lambeth Road, and the surface roundabout with the remaining traffic. During the rush hours some 2,300 vehicles will use the upper roundabout, absorbing six of the heaviest traffic lanes, and 3,200 vehicles will use the lower one. The scheme is estimated to have a reserve capacity of about 75 per cent on present-day use and will reduce appreciably the time taken by vehicles to pass through the intersection. The estimated cost of the improvement is £3 million which has been approved in principle for grant purposes by the Minister of Transport. It is hoped that work will begin in 1965. When completed the new intersection will be a main distribution point in south London for traffic coming down from west and north-west London via the current Hyde Park Corner/Marble Arch improvement scheme and the improvements being planned for the Victoria Station area and at the northern end of Vauxhall Bridge.

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next month . . .

Saturation Flow of Traffic at Light Controlled Intersections

Brian Helm, M.Sc., formerly Rees Jeffreys Scholar, University of Durham

Report from the U.S.S.R.—Moscow's Urban Motorways

Professor A. E. Stramentov
Academy of Construction & Architecture, U.S.S.R.

Use of Pedestrian Subways in Urban Traffic Areas

L. A. Laffan, B.Sc.(Eng.)
Head of Traffic Group, Chief Engineer's Department, London County Council, and
R. A. Wright, M.A., A.M.Inst.T.
General Assistant to the Traffic Manager, British Railways

America's Toll Road System

Dr. Gilbert Walker
Professor of Commerce, University of Birmingham

A Years Traffic on M1.

G. R. Green,
Road Research Laboratory

Instruments for Traffic Engineers (6) Skid Resistance

B. D. Richardson
Lecturer in Highway & Traffic Engineering, University of Birmingham

Profile of Prof. W. Fisher Cassie

Professor of Civil Engineering, King's College, University of Durham, Newcastle upon Tyne

Traffic Engineering at the University of Birmingham

F. D. Hobbs, D.L.C., A.M.I.C.E., M.Inst.H.E., Senior Lecturer/Paviors Lecturer in Highway and Traffic Engineering.

An informal discussion on 'The Work of the Graduate School in Highway Engineering, University of Birmingham' was held at the Institution of Civil Engineers Traffic Engineering Study Group, January 26, 1961. The paper prepared by Mr. Hobbs is reproduced, with a report of the discussion.

THE adequate training of highway engineers has, in recent years, shown itself to be of paramount importance. Increasing use of the motor vehicle, with the resultant traffic congestion of our cities and towns, together with the heavy toll in human life and misery, affects the whole community both socially and economically. Limited capital investment in roads requires a new approach by engineers who are more highly trained, and fully aware of the interlocking factors in a wide field of knowledge, if sound solutions are to be found for the problems which face us. Methods of training acceptable in the past can no longer wholly serve today's need. University degree courses of three years duration can and do provide the background knowledge of basic engineering fundamentals, but can do little more in the available time. Nor is it wise at this juncture to specialize too deeply before the graduate has had an opportunity to look at civil engineering outside the universities, and decide the particular type of work he is most interested in and for which he is suited.

The postgraduate course at the University of Birmingham is designed to provide the wide background to highway and traffic work necessary today, with technical mastery of traffic study, operation, design and construction. This is achieved by lecture courses as shown in Table I, supported by visiting lecturers in each year's course to cover specialized subjects and at the same time to provide different viewpoints and stimulate discussion. It is important also to have wide contacts with industry, whether it be local authority, consultant, government or contractor, and these contacts are cultivated by visiting lecturers. A typical year's external lecture course follows.

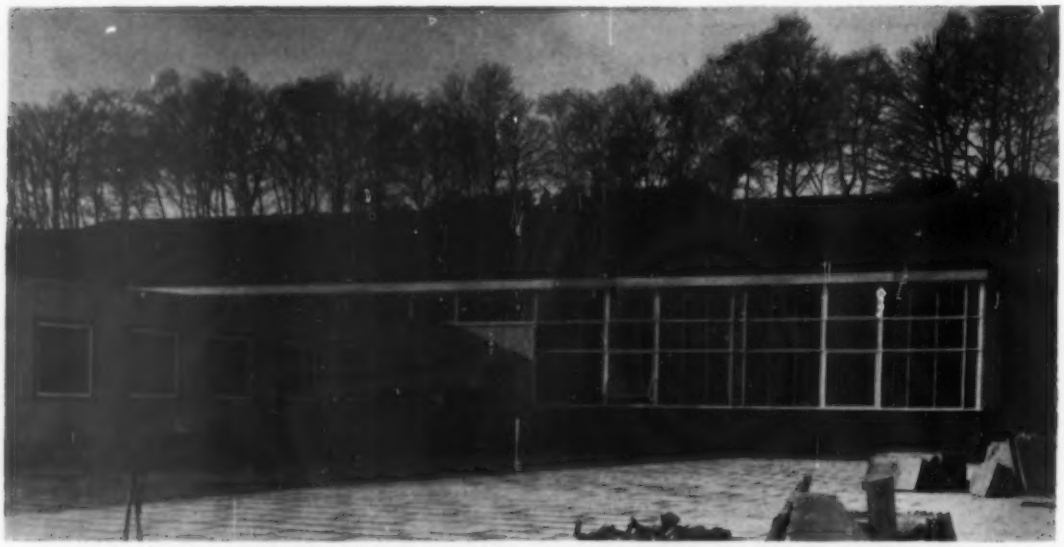

Fig. 1. Drawing office of the Graduate School of Highway & Traffic Engineering, University of Birmingham.

Session 1959-1960

Mr. C. F. Armstrong (Ministry of Transport).
The work of the Ministry of Transport's experimental section.

Mr. P. G. Boosie (R. M. Douglas Ltd.).
The organization of a large contractor with special reference to highway work.

Dr. L. F. Cooling (Building Research Station).
Past and present research on soil mechanics at the Building Research Station.

Mr. H. M. Ferguson (The General Electric Co. Ltd).
Street lighting research.

Mr. E. W. Hinchley (British Road Tar Association).
Road tar and its uses.

Mr. H. R. Hollington (Cement & Concrete Association).
The structural use of concrete in elevated roads.

Mr. A. W. Jarman (Shell Mex & B.P. Ltd.).
Bitumen and its uses in road engineering.

Mr. F. Jepson (County Surveyor, Staffordshire).
The highway work of a county authority and the organization of direct labour schemes and maintenance work.

Mr. A. J. A. Lee (Royal Automobile Club).
Motoring organizations and policy towards the highway needs of Great Britain from a motorist's viewpoint.

Sir Herbert Manzoni (City Engineer, Birmingham).
Traffic congestion in large cities.

Mr. H. J. Donovan (Sir William Halcrow and Partners).
Tunnelling methods in the United Kingdom.

Mr. H. G. Dawe (Hunting Aero Surveys Ltd.).
Aerial surveying.

Mr. S. Rodin (George Wimpey & Co. Ltd.).
The analysis of problems in soil mechanics and its influence on construction methods.

Mr. J. P. Stott (Road Research Laboratory).
Research into the use of concrete highways with special reference to prestressed concrete roads and thin slabs.

Mr. J. L. Waldron (New Scotland Yard).
The control and regulations relating to traffic from the point of view of the police.

Mr. D. P. Weeks (John Laing & Son Ltd.).
Problems connected with the construction of the London-Birmingham Motorway.

Mr. C. M. Wilcock (Aveling Barford Ltd.).
The design and operation of plant in highway work.

Drawing Office Projects

In order that the inter-relationships of lecture subjects can be integrated with design, a number of drawing office projects are carried out. These designs are of great importance because they enable discussion of the problem between staff and student and the interchange of knowledge is facilitated. Drawings and full reports are prepared and submitted for assessment at the end of the year. The following list of subjects indicates the type of work covered in the 1959-60 Session:

Alignment and Location: Preparation of plans and sections for a motorway location through difficult country in the Cotswold Hills south of Cheltenham. Special attention paid to amenity areas and aesthetic conditions on the motorway and from surrounding scenic points.

Improvement and Realignment of existing Roads: Preparation of full plans for the improvement of a length of a rural Class 1 route including design of reverse curves, superelevation, minor road intersection, drainage, etc.

TABLE I
Session 1960-1961

Lecture course title	*Lecture Periods*	*Laboratory and/or Field Work*	*Project Research*	*Drawing Office Projects*
Materials Engg.	25	20		
Soil Mechanics	25	40		
Hydrology	10		75	150
Design and Construction	25			
Traffic Engg.	80	50	75	
Planning	10			
Statistics	25			
Aerial Surveying and Photogrammetry	20	5		
Economics	25			
Law and Administration	10			
Medical Aspects	5			
Geophysics	5	5		
Totals:	265	120	150	150

Town Development Scheme: Design for a new town major road town centre layout including pedestrian precincts and the design of a medium capacity intersection including street lighting.

Major Urban Routes: General design of a major urban route including grade separated intersections, adjacent development areas and local roads from traffic data collected during the course.

As the understanding of traffic alone can in no case provide the most acceptable solution, and the choice and use of correct materials must be fully understood, laboratory courses are undertaken in the primary fields of concrete, tars and bitumens, roadstones and soil mechanics. In addition, a research project is carried out in groups of two or three for a term and a half. Subjects being covered this year are shown below:

Cement stabilization of coarse grained materials.
Correlation of roadstone tests with petrology.
Polishing of roadstones and skid resistance.
Road alignment model.
Flexible pavement design theories.
Model tests on elevated structures.
Stabilization of medium grained materials.
Moisture movement under pavements.

On completion of the work, reports are duplicated and circulated amongst all students. Each topic is then introduced at a separate seminar by the group responsible. Previous years' work is available in the graduate library and, in this way, students become familiar with the whole range of work undertaken and the studies can be extended from year to year.

By the kind co-operation of many authorities and firms, visits are arranged each year to research laboratories, construction sites, exhibitions and manufacturers. Those undertaken for the session 1959-1960 follow:

Parking exhibition at the Institution of Civil Engineers.
Hunting Aerosurveys Ltd.
Cresswell Viaduct—Staffordshire County Council.
Inner Ring Road and other works—City of Birmingham.
Aveling Barford—road construction equipment.
Grantham By-Pass.
Ross Spur Motorway.
Goodwin Barsby—quarry and road surface mixing plant.
Birmingham-Bristol Motorway.
Motor Industry Research Association.

The school is particularly fortunate as the Civil Engineering Department, of which it is a part, has this session moved into new buildings. (Fig. 1). Nearing completion, and erected on the same site and designed to cater for the individual requirements of the highway and traffic course, is a further administration and laboratory block. (Fig. 2). The money for this was provided from the £140,000 (£20,000 p.a. over seven years) fund set up in August 1959 and collected by industry. After the initial appeal of the Worshipful Company of Paviors, their sponsoring of a lectureship and the support of the University, the course was established in its present form in October 1957. This was after two very successful summer courses had been held in the years 1955 and 1956.

The Student Body

Students who have attended the course have come from all fields of the British Local Government Service, consultants and contractors. In addition men from most countries of the Commonwealth have studied here, including a number of graduates from American universities who would in all probability have undertaken their post-graduate courses in the U.S.A. but for the new opportunities in Great Britain. The course is open to approved graduates from British or foreign universities to work for an M.Sc. degree, and for non-graduates with suitable professional qualifications to work for a Diploma in Graduate Studies. The awards are made after satisfactory completion of written examinations in the major subjects during June and the submission of approved practical work, together with drawings and reports of course work. Practical summer work is undertaken in the summer period from July to October and during this time the student is able to work in a branch of highway and traffic engineering, concentrating on his particular field of interest. A title and subject content is agreed for each individual summer project and a report is required.

One of the greatest problems today is the financing of candidates from the meagre resources available. In general, the overseas student is fairly adequately catered for, although there is intensive competition for the scholarships that are available. The case of United Kingdom engineers, often married and with a family, is particularly acute. I feel that

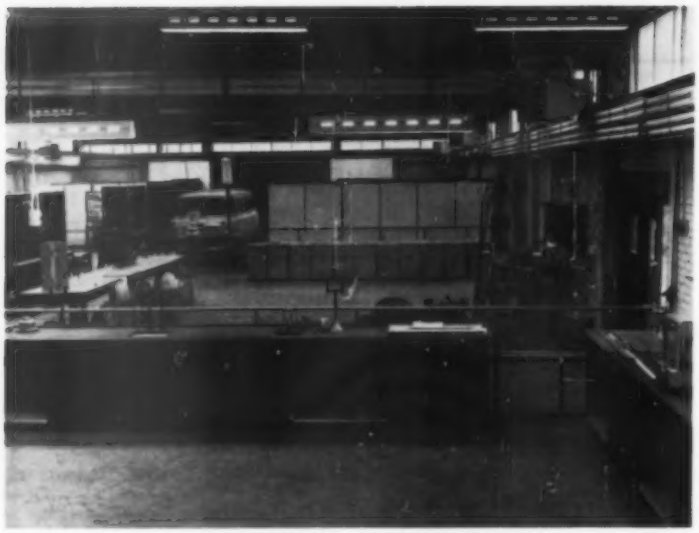

Fig. 2. A section of the main Highway & Traffic Laboratories.

it is in the interests of the profession as a whole that more scholarships are made available through industry, local authorities, and learned societies.

Although the term 'traffic engineering' has received wide publicity here in the past few years, the subject has been studied under different descriptions since the days of Rees Jeffreys at the turn of the century by many British engineers. In fact, traffic engineering legislation in this country can be traced back to the Highway Act of 1835.

The lecture course is split broadly into the following groups.

The Road User and the Vehicle: the physiology and psychology of the various types of user and their reaction to the traffic environment. The types and characteristics of performance of vehicles in the traffic stream and within the varied circumstances of the highway network system.

Traffic Studies: methods of measurement and characteristics of volume, speed, delay, origin and destination, assignment, traffic trends, diverted and generated types of traffic, accidents and parking studies.

Theories of Traffic Flow and Capacity: the fundamentals of traffic flow on roads and at intersections.

Traffic Operations and Control: signs, signals and markings; street lighting, and the efficient use of existing street systems.

Geometric Elements and Design: layout and design of highways to meet traffic demands, including the design of all types of intersections; improvements to existing highways to increase capacity and safety; design of parking facilities.

Road Safety and Accidents: the human element and its relationship to road safety; before and after studies; vehicle design and crash injury.

Economic Requirements: inter-relationship of transport facilities; finance for road investment; detailed study of applied economics to the comparison of schemes.

Traffic Legislation: the need for and adequacy of national and local legislation.

Town and Country Planning: planning aids and needs; land use; civic design; roads in relation to buildings and open spaces; the development and use of resources; the pedestrian and the vehicle.

The traffic laboratory course includes the use of a variety of instruments and the analysis of the results. Most of the work is carried out in the field and the work to be undertaken this academic year, 1960-61, follows:

Moving car observer studies.
Traffic counters and analysis of volume data.
General speed and delay measurements.
Headways measurements.
Skid pendulum.
Street lighting measurements.
Traffic signal studies.
Speed, volume, headway measurements.
Capacity Study.
Fuel Measurements in different traffic circumstances.

In addition, one day a week for the duration of a term and a half is spent on a traffic engineering project conducted in a similar manner to the previously described materials project. Here again, the work is concerned with research into some specific aspect of traffic engineering, and the students normally work in groups of two or three. Some of the projects undertaken during the session 1959-1960 follow:

Investigation of traffic signals (before and after study).
Driver acceptance of merging and crossing headways.
Parking survey: generation of demand by type of office and premises.
Spot and journey speeds. Urban and rural areas.
Street lighting, surface characteristics and geometric layout at selected sites.
Stream and lane headways on four and two lane roads in urban and rural conditions.
Volume and capacity studies in central areas.

Whilst the major task over the last three years has been the establishment of the School and our primary responsibility the training of highway and traffic engineers, a general programme of research has been initiated into some traffic engineering and other problems. It is hoped that this work may be extended in the future.

Work being undertaken at present includes the development of instruments for measuring traffic characteristics, mainly volume, speed and headways. Use has been made of some of these in the study of the traffic stream at a number of urban and rural sites, including the acceptance and rejection of gaps in the stream for merging, diverging and crossing movements at intersections. A series of origin and destination studies particularly related to traffic entering the large Midland conurbation has been carried out during the last year. A number of general studies, which are being continued, has included delay, fuel consumption, speed, volume, surface characteristics, road layout and street lighting.

Also of particular importance is the use of land in the generation of traffic both by type and pattern, and a number of such investigations are proceeding. These studies to date have included the modes and habits of pedestrians and office workers and their methods of travel to and from work.

Photogrammetric techniques are also being developed, as applied to such problems as the aesthetic considerations of route design and location.

The scope and range of the knowledge required by today's highway and traffic engineer is wide. It is necessary that the correct approach to our problems, which have such great social and economic bearing on the lives of the community, should be undertaken by adequately trained engineers sympathetic to, and well acquainted with, today's needs. The total costs are but small in relation to the achievement of a safe, efficient and balanced highway system.

DISCUSSION

In opening the discussion on his prepared paper, Mr. Hobbs said that the course described made a modest start in 1957 with three students; the number increased to ten in 1958, and to 23 in 1959 and 1960. An expansion would now be possible following the recent move into new laboratories and administration wings, which comprised a complete set of laboratories covering both materials and construction and the important traffic field, and equipped with most types of instrument. There were also two mobile traffic laboratories.

The major activities of the course could be listed under six headings:

(1) Formal lecture courses and seminars for the various subjects covered, supported by students' own reading.

(2) Laboratory and field work where use of instruments was taught and analysis of data carried out. Actual road and traffic problems in the Midlands were considered, and in such a way as to be of value to the authorities concerned.

(3) Drawing office projects in which special problems were set.

(4) Materials and traffic projects, which allowed more difficult and wider experiments to be undertaken, including research.

(5) Visits to sites and research associations and lectures drawn from outside the University.

(6) Practical work undertaken by all graduates for three months in the summer, generally outside the University.

A contributor to the discussion welcomed the introduction of economics into the programme of work, which was important to the development of the graduate engineer. It encouraged the students to take a wide view of transport problems and to look at the transport problem as a whole.

Another activity, related to new investment in roads more than to the congestion problem, was the economic criteria that could be set up for judging the worthwhileness of projects. As a lecturer at the university, he had found it useful to criticise such rules of thumb as cost-benefit ratios as developed in the United States. That interested the students and evoked useful discussion. He added that it was important to combine the economist's and the engineer's approaches in regard to road building projects, to get right into the local authorities, right at the grass roots of where the projects developed.

Another speaker questioned whether, in the course as outlined, the balance between traffic and materials was in fact justified at the present stage. He suggested that the actual balance in the economy between those concerned with materials, including contractors and consultants, and those concerned with traffic, was lopsided, since the traffic problem existed on 192,000 miles of road, with which all the inhabitants of the country were concerned. He wanted to know whether the course touched on the philosophy of traffic, because he was concerned that those involved in traffic tended to deal only with their own problems. He asked whether the students were given any idea of the much bigger impact and how one could affect an area by means of road building. One might get traffic on those roads, but one might not be certain that it was the traffic at which one was aiming. Should not more time be given in the syllabus to the traffic problem?

Demand for Traffic Engineers

Speaking of the demand for traffic engineers, he suggested that in the next 25 years there would be a demand for up to 900 trained, registered professional traffic engineers who, because of the size of the subject, could not do anything more than know broadly about the associated subjects. He thought this indicated the necessity to train many more specialist engineers for traffic purposes than was being done at present. Another problem was the training of lecturers and teachers in traffic engineering. Were those who took the course at Birmingham or Newcastle upon Tyne fit to lecture to the vast number of people who demanded courses? Should they not think in terms of teaching people who could then take from the Ministry or the Road Research Laboratory the burden of getting it over to the new generation?

In reply, Mr. Hobbs said that as to the balance between construction and traffic, the problems were more difficult here than in America. This country had less to spend, and had less room, and ancient monuments and cities to preserve. The engineer, therefore, had to be better in traffic and in construction elements than the Americans. Consequently, he thought that the balance that they had struck was about right and was about 50-50, perhaps with just a slight emphasis on the traffic side. Teaching was a great problem. They had great difficulty in getting staff. Short courses were an important part of training and revision for engineers already practising. Colleges of advanced technology could assist by increasing the number of locally available centres for courses of two or three weeks' duration.

A contributor speaking with knowledge of the practical work done by students in his own section of Worcestershire said copies of the resultant plans were in his own office, and were referred to. The work of the students was, therefore, not entirely theoretical; it was useful to them for the purpose of their course and it was also useful to his department. When they wanted assistance and information from the University, they got it. They had already set up that co-operation, and he was sure that it would go on. There was very useful co-operation between the authority and the University. He suggested further interchange was required of information between all the universities engaged in traffic engineering and those practising it, because the work of each was of interest to the other. Much of the University work was of general interest, and there was need for some central collecting and distribution service to deal with the information.

Mr. Hobbs replied that they were deeply indebted and grateful to the local authorities around Birmingham University who permitted them to undertake projects on their roads. This was a most important part of the training. Without the help of such authorities, it would not be possible to accomplish much in actual practice. Concerning publication of information, there was a need for such an exchange between local authorities and the universities in respect of the work that was being undertaken, and he referred to TRAFFIC ENGINEERING & CONTROL which was interested in disseminating such material.

Another contributor suggested that Mr. Hobbs's paper showed how traffic engineering could, and should, stand alone as a subject for study and practice in its own right, not linked with highway engineering, and certainly not subordinate to it. Of the 38 items of instruction in the syllabus, nine were pure highway engineering, 23 were pure traffic engineering and the other six were combined exercises in which other faculties could equally well join. Since the separation of traffic engineering from highway engineering was possible, he suggested that they could usefully consider it as a not unduly long-term aim. Highway engineers built and maintained an end product—the highway system. Traffic engineers should be in charge of its day to day use: they operated what the highway engineers produced.

Mr. Hobbs said that in his view, traffic engineering should not be a separate subject. Nobody knew precisely where traffic engineering stopped and where highway engineering started. He thought there was a case for technologists and possibly laboratory technologists for site investigation work, and there was probably also a case for a technologist traffic man who would do such work as traffic recording data and analysis under the engineer. There was nothing to stop an engineer once he had been trained in those basic fields, which were all interlocking, becoming purely a traffic engineer at a later date, but for the rest of his life he would at least be aware of the other problems that arose. Speaking personally, he thought the present situation represented the correct approach: people did their general courses and if later on, like the medical profession, they wanted to specialize, they could do so.

Three questions were put to Mr. Hobbs by one contributor. (1) Did Mr. Hobbs believe that the university was the proper place for teaching traffic engineering? (2) What did he think about an undergraduate course in the subject? (3) What were his views on transportation?

Mr. Hobbs replied that he certainly thought that the university was the proper place for teaching traffic engineering. There were courses for several types of engineering—about 20—and they seemed to be acceptable to those who wanted to take them. He thought that undergraduate courses were already overloaded, and most universities had great difficulty in deciding what they were going to cut out for the next year. Unless the undergraduate course was extended to five years, like it was on the Continent, it was better to teach the fundamentals of hydraulics, structures and strength of materials at that level.

At Birmingham they dealt with transportation under the guise of economics, in connection with which road, rail and water transport were dealt with.

Leeds University Course

A contributor said that at Leeds University, where he was a student, highway engineering was included at postgraduate level as an optional subject. Some traffic engineering, but only a small amount, was introduced during the second year so that students had some idea of both traffic engineering and road construction. It was also an optional subject in the final year, but if the student wanted to go into highway engineering he could choose it in his final year. Structures, hydrology and soil mechanics were compulsory in the final year so that the student had a basic grounding in the main elements and background of civil engineering. The student could choose between certain other subjects, including surveying, architectural engineering, highway engineering and traffic engineering.

One contributor said it was his function at the Road Research Laboratory to act as superintendent and registrar of its short courses. He recalled that a recent conference on the Highway Needs of Great Britain had suggested there was need and scope for courses of all kinds at all levels—postgraduate, undergraduate and short full-time or part-time or evening courses for practising highway engineers. Such few evening courses as had become available recently had attracted a heavy response.

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Economic Commission for Africa

INTERNATIONAL ROAD FEDERATION PROPOSALS

The Economic Commission for Africa met in Addis Ababa in January and the International Road Federation submitted a paper which is reproduced below on the development of international roads on that continent.

HISTORICALLY the great African Continent has emerged area by area, and territories have tended to grow up as separate and self-contained economic and social entities. This has been the inevitable result of the great distances to be covered, the physical barriers and the climatic conditions, all of which have mitigated against any systematic regional development. The existing communication network has, in its turn, shown the same lack of co-ordination over a wider area. Instead of inter-territorial road links, emphasis has, in the past, been on linking the producing centres in the interior with the main shipping ports, and in developing systems of feeder roads to these links.

Today, however, the whole pattern of African life is changed. The move towards greater independence has brought with it a move towards greater self sufficiency, with all countries striving to develop their own industries for the production of consumer goods instead of relying entirely on overseas products. An important factor which has contributed substantially to the need for changing the hitherto traditional pattern of export and import, can be found in the fluctuation in the prices of Africa's raw materials on the world markets. Africa is now increasingly compelled, for economic reasons, to make the maximum use within Africa of her own home produced raw materials.

At the same time, in the individual territories, the market for goods and materials is often still insufficient to make production an economic proposition. A solution to this lies in inter-territorial trading—at present virtually non-existent. But to make this feasible, improved inter-territorial communications are a *sine qua non*. It is here that new roads can play a vital and invaluable role, both because of their flexibility and because of the comparative speed and economy with which they can be constructed.

E.C.A.'s Tangier Resolution

The International Road Federation therefore welcomed the resolution adopted by the E.C.A. at its meeting in Tangier in January to February, 1960, which reads:

(*a*) The E.C.A. . . . requests the Executive Secretary in the execution of the programme for 1960-1961, to pay particular attention to the following priorities which reflect urgent needs in the economic and social development of African States and Territories . . .

(*b*) Problems of industrialization and transportation in African States and Territories in their national and regional context.

For the implementation of the transport aspect of this resolution, I.R.F. ventures to put forward the following tentative suggestions:

(1) Transport Regions

It is clearly of primary importance to establish the transport regions. Equally clearly it is impossible at this stage to divide Africa up into a number of neat transport regions.

It does appear, however, that there are three regions which would benefit considerably if work in the regional transport field were initiated forthwith by E.C.A. viz:

(*a*) The West Coast Transport Region which would comprise the countries which lie to the south of the Sahara from the western coastal area to perhaps Cameroon and Chad.

(*b*) The Eastern Horn Transport Region which would comprise the countries bordering the southern Red Sea and northern Indian Ocean.

(*c*) The Nile Valley Transport Region which would comprise the riparian countries of the Nile and White Nile.

(2) Steps to Develop Inter-regional Transport

In all these three regions there are today tracks or minor fair-weather roads linking the territories of the regions; in very few cases indeed are these inter-territorial facilities in any way adequate for the development of inter-territorial trade, tourism or social exchange.

It is suggested, the first step should, therefore, be for E.C.A. to provide in each transport region a team or teams of transport economists whose duty it will be to investigate all existing inter-territorial transport facilities, assess the potential advantage of improving them to an adequate standard, and to allot priorities.

The second step should be for E.C.A. to provide engineering teams which would estimate the cost of improving those links which have been given priority by the teams of economists. In certain instances it will be possible to carry out step one and step two concurrently. This will save time.

The third step would be for E.C.A. to establish a regional road fund for each region. The purpose of these regional funds would be to provide finance for the construction of those portions of the inter-territorial roads which have a purely inter-territorial, as opposed to national, importance. The regional funds would be supplied by international financing bodies.

The fourth step would be for the engineering teams to prepare detailed specifications, etc. for the priority roads. Construction could then be carried out by the governments concerned.

It is believed that preparation for construction, that is the first four steps, would take at least five to six years. Construction might then take from one to four years. Therefore it seems of the greatest importance that work in this field should start as soon as possible.

(3) Transport Statistics

Transport statistics are lacking in most countries of Africa; such statistics are, however, a prerequisite to the production of sound transport plans for Africa. Road and road transport statistics are complicated and difficult to obtain. In suggesting the statistics which governments should provide, a compromise must be reached between the maximum that governments can reasonably be expected to produce and the minimum required for sound planning. It is suggested that E.C.A. should co-ordinate the work of governments in the field of transport statistics with a view to publishing such statistics annually for the whole of Africa.

(4) Vehicle Legislation

Work on the regional level would establish the regional through roads and, ultimately, the international through roads for Africa. The standards of these regional and international through roads should, as far as possible, be uniform, and they must depend upon agreed vehicle dimensions, axle loadings, etc. for international traffic. Such legislation must take into account the agreements reached in the International Convention on Road Traffic reached at Geneva in 1949.

It is essential, therefore, at an early stage to establish agreed vehicle dimensions for traffic on the regional and international routes. This from the outset should be worked upon on an all African basis.

It is suggested that the E.C.A. should arrange meetings of government transport officials, the purpose of which will be to reach agreement on vehicle legislation for traffic on the regional and international roads through Africa. From this agreement the standards of inter-regional and international roads will follow.

PROFILE *of a* TRAFFIC ENGINEER

Granville Berry

THE City of Three Spires. OUR three spires, Coventry's City Engineer and Surveyor calls them, with that warmth in his voice that is special to the pride and love inspired by a place. Then he goes on to talk of his wish to floodlight them so that their beauty might dominate, in darkness as well as daylight, the twentieth century city which has risen, phoenix like, from the ashes of the war. These three spires could each stand for one of the three great interests in the life of this man, whose distinction is recognized beyond his own country and who has received tribute in both Houses of Parliament. Incidentally, he is this Journal's consultant on street lighting.

Granville Berry's three ruling interests are local government, lighting and the City of Coventry, and they have come into his life in that order. He grew up in no doubt that he would follow the family tradition in local government, and his well known and respected uncle, Alderman Edgar Boothman, was Mayor of Granville Berry's native town, Nelson in Lancashire. To this town, he gives the highest praise any place can earn from him—its record in local government is very fine. Eventually, as a qualified civil and municipal engineer, he was to serve seven different local councils including Huddersfield, Nottingham and Preston, leaving, though always for advancement in his career, each one with regret. Although he retains a deep love of Nelson, there is in his voice when he speaks of Coventry, that note, never impersonal because it is too warm, which implies that the city itself has achieved its success—with its roof-top car parks at its centre, with the first heated approach ramp in this country, and work already well advanced on the bridges that will soon make it possible for cars to circulate the centre of the city at roof level. 'Coventry', Granville Berry maintains, 'has developed with unparalled rapidity' and the City Council is always prepared to 'have a go'.

Coventry's reconstruction and its planned City Centre, with pedestrian precints and covered ways, have been described and illustrated often. However, more gradually becoming known to the public, though long valued by authorities and experts, is his 'pushing advocacy', as he himself calls it, of the paramount importance of lighting, a subject which he first became interested in while in the Royal Borough of Kensington. This was in the early nineteen-thirties, crucial years in the field of lighting. Now, there is practically no aspect of street and highway illumination with which Berry is not concerned—its value in reducing accidents, the relation to it of different coloured road surfaces, the rapidly changed needs of the new motorways, the practical construction and mechanics of lighting fittings, the economics of good lighting both as to direct cost and in the elimination of darkness delays, the psychological aspects of relief from nervous tension; in fact, everything that adds up to the fullest and safest use of roads by night.

He gives close attention to the findings of this country's own Road Research Laboratory—he is Chairman of its Street Lighting Sub-Committee—and a member of the Board itself. Granville Berry has said publicly that Great Britain has the best lighted road system in the whole of Europe. While we are, perhaps, surpassed in the matter of individual lighting installations, having nothing to compare, for instance, with one in the centre of rebuilt Rotterdam, we have a far greater sheer mileage of classified roads with good lighting. Not that he sees in this an excuse for resting on our laurels.

It should come as no surprise to find in an engineer, so often dealing with a balance of niceties, a strong sense of justice. Granville Berry's fairness is fused with his feeling for people and a touch of fun. A somewhat severe face is brightened by frequently twinkling eyes: they twinkled when he said of his address to the International Congress which met at Brussels Exhibition of 1958. 'Anyway, it made a good reason for going to Brussels'.

The list of Berry's council memberships, chairmanships and presidencies, is enormous. Yet this man, whose public utterances have instigated Parliamentary debate and who has himself addressed a meeting of the All-Party Roads Study Group in the House of Commons, finds that no honour thrilled him more than the invitation to present the prizes at his old school—the Grammar School at Nelson.

Like many men of achievement, he regards himself as lucky in having a wife who shares many of his interests. Of his children, a daughter aged eighteen and a son who intends to read law, he says, 'They still sometimes let me play tennis

(*Concluded on page* 679)

Letter to the Editor

TRAFFIC FLOW - THEORY OF FLUID PROBABILITIES

From John Gould, A.M.I.B.E.

WHEN planning a new facility (road, bridge, roundabout, etc.) it is not practicable, nor is it desirable, to design for a traffic density covering a period of time which is greater than one can, or should reasonably assess. Up to the present, long range prognostication has proved fallacious and, in far too many cases, huge sums of money have been expended for works which have proved inadequate not to say unsuitable long before the calculated date for saturation. Typical examples are the Los Angeles and Detroit freeway systems.

Another important factor, which far too many traffic engineers (particularly in the U.S.) choose to soft pedal in the initial plan stage, is the monetary angle of the project in its relation to the already overburdened local economic position.

Paradoxically the more practical long-term policy is to plan for a not very distant future saturation date. Reasonable current assessment should not extend beyond seven years and the design policy governed by the law of 'Fluid Probabilities'. The design should allow for only a relatively small amount of modification, then, when and if the traffic circumstance develops to the point of utter saturation, assume intensified control, (more police control and regulation) and wait for the inevitable driver awareness reaction to the situation. Most probably this will take the form of enforced self-help. A fair proportion of these frustrated persons will inevitably think of an alternative to get around the intolerable situation, and the action will probably be one of the following:

(*a*) He may choose an alternative (longer) route.
(*b*) He may use the park-and-ride plan involving the use of public transport.
(*c*) He may decide to move his abode nearer to his work.
(*d*) He may decide to change his job to one nearer home.

This policy of enforced self-help has been tried, very successfully in many urban areas, particularly where the circumstance of a tight economy absolutely preclude any grandiose schemes of wholesale demolition and rebuilding. One noteable example is that of the Christchurch (New Zealand) solution. The situation in the downtown area, where there is a merger of six streets debouching into a square, had become impossible. The traffic department instituted a 100 per cent one-way system for a.m. and p.m. peak hours. For two or three days the traffic situation became nearly chaotic and needed the presence of 50 per cent of the department personnel. Towards the latter end of the week, quite a noticeable improvement was observed and, in a matter of six days, the bottleneck situation had been eliminated. A later survey elicited the fact that the majority were using alternative routes, which, although in most cases were longer, actually took less time between home and work.

For the ultimate success of this policy it is imperative that the planning and traffic engineers keep a sensitive finger on the pulse of the new traffic trend and, when the new trend is reasonably obvious, to proceed immediately and provide the necessary modifications and, if required, some new facility. This will encourage continued use of the new route, and maintain only designed traffic flow in the old facility.

The law of Fluid Probabilities has been pre-eminently exemplified in the case of London's New Towns. Basically, the idea was simply a form of syphoning off a proportion of the city's traffic, and the manner of implementing the scheme was based on the practical theme that, give a man a job which has all the promise of permanency, give him decent living accommodation near his job and, probably, he will move to the locality where these circumstances are in being, even if it means forsaking a locality in which he has lived all his life.

In Los Angeles, Detroit, New York City, and in other large cities in the U.S. where expressways have been built on a large scale, the city is slowly, but surely, being denuded in population and to some extent of large retail houses. Townships of fair size (70,000 is not uncommon) are springing up all around the outskirts of the city, and there is no hope that in the forseeable future these townships will be incorporated into the city. It is only a matter of a few years when a fair proportion of manufacturing will also take itself out of the city.

The circumstance of this transition is not accidental. Since the city deliberately embarked on a policy of throttling public urban transport a matter of about 30 years ago, and the corollary, about 1940, the construction of a grandiose system of expressways, the cost of living and, more important, the cost of big business establishment has become intolerable. Small towns have been quick to size up the situation and, by the offer of very favourable inducements, have caused this exodus. So desperate has the position of the city's finance become that they have now resorted to a revolutionary plan of a city income tax on wages.

With regard to Los Angeles, about 18 months ago, the realization had been forced on the city's traffic bodies, that the expressways, on which about one thousand million dollars had already been spent, are not after all, the answer to the problem of immobile traffic. Their new thought is a complete break from highway transport—a mono-rail system. At the time of my last recent visit, the city had engaged consultants to work on the feasability of the scheme, but nobody would dare to commit himself even to the extent of hazarding a guess at the fearful cost of implementing this scheme.

The plain and inescapable fact which the Los Angeles authority chooses to ignore, although knowing it full well, is that once the convenience of having one's own transport has been established, nothing short of absolute deterrent, or token free, adequate and comfortable public transport will make him forsake his own transport to travel back and forth to work. In this connection, it may be safely assumed that public transport on pleasure bent is unthinkable to the family which owns a car.

In conclusion, it is my contention that the days of planning for huge urban expressway systems are over, and that there never was a natural excuse for them, in that much more could have been done in modification of existing facilities and at a fraction of the cost.

46a York Road,
Southend on Sea, Essex.

Profile

Concluded from page 678

with them'. He expects rivalry in his family, since both children were born in Yorkshire and everyone's individuality, a child's no less than an adults, is to be respected. He finds it difficult to advise children, beyond telling them to seize opportunities and not to be afraid of hard work. Example he holds better than precept, and his children certainly have a large slab of good example to follow, for his work on roads and his colossal involvement in public lighting are not the total of his responsibility. Besides these, there are housing and reconstruction, sewerage, and sewage disposal, the prevention of river pollution and the construction and maintenance of all types of buildings. His domain covers too the extension of the use of radio in the control of street lighting, traffic signals and vehicles. It also includes runway construction at Baginton Airport. During the past twenty-five years, he has averaged at least one paper a year to national and international conferences and he has written articles, books and reviews.

Perhaps in the not too distant future, when the reconstruction of Coventry is complete, and while the youth of the city may be playing football on floodlit sports fields, the city Engineer and Surveyor of Coventry, Mr. Granville Berry, will be able to get back to his programme of reading one biography a month—to learn how other people surmounted their problems. Or perhaps he will just relax with a favourite thriller by Agatha Christie or Ellery Queen. **R.L.**

CAR PARKING SURVEY

As reported in last month's Traffic Engineering & Control, the British Road Federation has invited local authorities to supply information parking and has provided them with the necessary questionnaire, which is reproduced below

Name of Local Authority ..... (Ref. .....)

Population .....

When answering the following questions will you please have regard to these definitions:

Cars	All vehicles.
Kerbside Parking Places	All authorized street parking places including metered spaces.
Public Off-street Surface Car Parks	Parking places away from the street open to all-comers, the provision of which involves no more than enclosure, hard standing, huts, etc., for attendants.
Public Off-street Parking Garages	Above or below ground buildings, rooftops, etc., having ramp or other access including mechanical handling facilities, and available to all-comers.

		Municipally owned		Privately owned	
1. *Public Off-street surface car parks*	Number				
	Total max. capacity				
	Typical range of charges	Period / Charge		Period / Charge	
Public Off-street parking garages	Number				
	Total max. capacity				
	Typical range of charges	Period / Charge		Period / Charge	

2. Assessment (if available) of maximum numbers of cars parked in central area		Typical week-day		
		Up to 2 hrs.	2-4 hrs.	Over 4 hrs.
	At kerbside			
	Off-street			
		Peak day		
		Up to 2 hrs.	2-4 hrs.	Over 4 hrs.
	At kerbside			
	Off street			

*insert local peak day (e.g. Saturday, Market day etc.)

3. Has Council/Department made a study of ultimate parking requirements in central area?	Tick whichever is applicable: Yes ☐ No ☐ If YES—Estimate of car parking places to be provided ..... Made up as follows: (i) at kerbside ..... (ii) in public off street surface car parks ..... (iii) in public parking garages ..... No. of garages covered by (iii) above .....
4. Are the results of any parking study incorporated in The Statutory Development Plan?	Tick whichever is applicable: Yes ☐ No ☐ If YES—Does The Development Plan designate sites for: (i) Public off-street surface car parks: Yes ☐ No ☐ If YES—No. of sites ..... (ii) Public parking garages: Yes ☐ No ☐ If YES—No. of sites .....
5. Estimate of annual percentage increase in cars seeking parking space in central area since 1958.	..... %

6. Does the Council/Department contemplate a scheme for control of the KERBSIDE PARKING by meter or other means?	Tick Whichever is applicable: Yes ☐ No ☐ If YES (i) Estimate of maximum number of metered kerbside parking places ..... (ii) Would meter charges be on London pattern? (i.e. 2 hrs. 1s. 1 hr. 6d.) Yes ☐ No ☐ (iii) If 'NO' to (ii) above give details of charges: Period / Charge
7. In the opinion of the Department should Public OFF-STREET SURFACE car parks be free of charge?	Tick whichever is applicable: Yes ☐ No ☐ If NO (i) State specimen scale (ii) Is this specimen scale: Estimated ☐ Actual ☐ Period / Charge
8. In the case of public OFF-STREET PARKING GARAGES (a) What would be the cost of a 35,000 sq. ft. site in the centre of your town?	Minimum £ ..... Maximum £ .....
(b) Have the economics of an OFF-STREET PARKING GARAGE on such a site been worked out?	Tick whichever is applicable: Yes ☐ No ☐ If YES: (i) Capacity of garage in car spaces ..... (ii) Estimated cost per car space exclusive of land £ ..... (iii) Would it be: Wholly municipal enterprise or Joint municipal/private enterprise (iv) Would it be: Garage only or Combined garages, shops, service station, etc. (v) What is the estimated economic scale of charges for parking in such a garage? Period / Charge

9. What, in your opinion, is the average daily cost of getting to work in your town by public transport? (If some charge is made for ALL long period parking, the marginal user would have the choice of meeting that charge or using public transport).	Cost per day	None	Some	Most
	Less than 1s.			
	1s. to 2s. 5d.			
	2/6 to 4/11			
	5/- to 7/5			
	7/6 or more			

Tick one for each price range

10. Is planning consent for new building dependent upon the developer meeting defined car parking provisions?	Tick whichever is applicable: Yes ☐ No ☐ If YES—The requirements are:

Requirements	Does not apply (enter X)
One car space per ..... sq. ft. in offices	
One car space per ..... sq. ft. in industrial buildings	
One car space per ..... sq. ft. in large shops and stores	
One car space per ..... houses or flats	
One car space per ..... guests in hotels	
One car space per ..... seats in cinemas, etc.	

Public Lighting Maintenance

by L. R. Osgood

An example of modern public lighting.
Photo by courtesy Holophane Ltd.

At the Association of Public Lighting Engineers, London and South-East Section, Mr. Osgood spoke on maintenance of public lighting installations on Jan. 26, 1961 and his paper is reproduced below.

PUBLIC lighting—like a theatre cast has its star performers and its supporting players. The tip-top lighting engineer—of whom Britain has a goodly share—quite rightly takes pride of place. He schemes, plans, organizes and eventually produces a first class lighting installation. However, the finest scheme will come to naught unless suitably maintained. It is on completion of a street lighting scheme that the Public Lighting Superintendent takes over and assumes responsibility for keeping the installation in efficient working order. His activities can be grouped under three headings: organization, administration and supervision. The purpose of this paper is to consider very briefly the impact of the changing scene on these activities.

In the past, organization had to take into account extensive gas lighting schemes. Very often maintenance was carried out on foot by a lighting attendant who carried a ladder and small bucket for cleaning purposes. He was also called upon to wind and set the controllers once a fortnight. Territorial allotments had to take into account distance between lamps—ratio of lamps in culs-de-sac to straight through runs of lamps—hills and isolated lamps on estates. The practice of making allowance for lamps in areas dominated by iron moulding works or chemical factories still applies today. Night patrol was carried out on foot or by cycle.

Today, with electric lamps rapidly superseding gas lamps the scene changes. Cleaning becomes necessary less frequently. Except for areas supplied by D.C., hand wound controllers have given way to synchronous controllers, ripple control or some other more modern method. In the case of night inspection, this can and often is carried out by a small van. Thus, the same area, but with more lighting, can be organized using the same number of men or even fewer, provided the gas boys are willing and able to learn the new techniques necessary to maintain an electric street lighting installation.

In the past, administration seldom required extensive records. A preponderance of filament lighting, usually burnt to destruction, required little beyond a list of lamps used. The daily fault sheets and the weekly time sheets completed the clerical work and both the Superintendent and his Deputy were able to exercise a very tight supervision. Today, with its ever increasing use of gaseous discharge lighting, brings the problem of lamp renewals into prominence with three possible solutions.

(1) *Burn to destruction.* This method can be used with tungsten lighting on housing estates. It is not advisable with discharge lighting or tungsten lighting on main roads.

(2) *Territorial group change.* In this system a road or area is group changed on a certain date regardless of premature failures. The change can be planned to coincide with a cleaning period. This system has the advantage that it does not require extensive records. Its disadvantage is that it is wasteful and coupled with malicious damage, accidents and prematures can play havoc with estimates.

(3) *Partial Group Change.* In this sytem each lighting point has a card which is filed showing all activities connected with that lamp. Such cards are consulted frequently and only lamps which have served their time are renewed. This involves very complete records being kept, and occupies a large portion of the Superintendent's time.

When control of manpower was a lot easier than it is today, supervision was carried out by the Deputy as his main occupation and also by the Superintendent. Today it is still largely the province of the Deputy, but the Superintendent will find much to occupy his time in the office, and his occasional visit to a particular part of the town will be in the nature of a snap-check, or to investigate a complaint not necessarily connected with maintenance. The increased use of transport to cover a large area in a quick time brings one problem. The Superintendent must keep a close check on the route followed. The driver is not always the best judge and his opinion is more likely to be affected by the amount of cheese in a roll, or the size and quality of a cup of tea in a particular cafe, than by any ideas Euclid might have held as to what constitutes a straight line. Both the Superintendent and Deputy must know the town thoroughly if supervision of present day maintenance is to be effective.

In the field of design and manufacture of lamps, lanterns and fittings the approach has been that of ease of maintenance. We have seen the disappearance of the 3BA non-captive screw, installed head downwards, which, once freed, ensured the collapse of all internal fittings in the lantern. Gone is the fixing screw made from a metal so far removed on the atomic scale from that of its seating as to ensure maximum corrosion in the shortest possible space of time. Today, there is a dearth of intricate parts inaccessible to even a baby's fingers, and clamps, hinges and movable parts are heavily weighted as a matter of course. The author rates the toggle clip fastening as one of the seven wonders of the twentieth century. The various tower wagons, vans and trailers on show at the A.P.L.E. Conference demonstrated that the manufacturer, aware of the maintenance man's problems and difficulties, is doing his best to provide first class tools for a difficult and sometimes uncomfortable job.

TEC357 for further information

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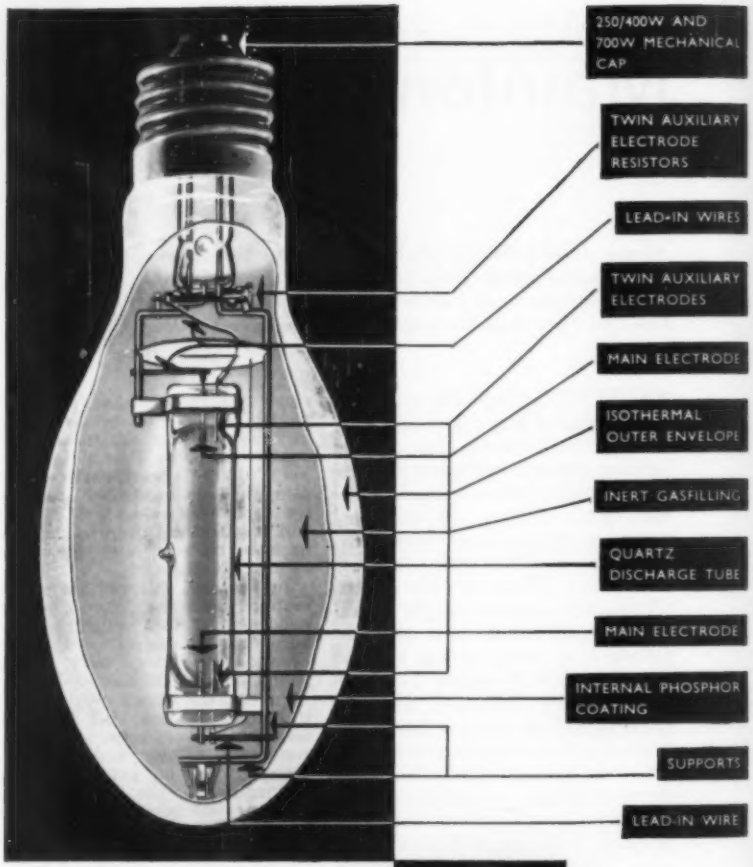

The unique Isothermal shaped envelope of this range of lamps—seven ratings, 50 to 1000 watts—ensures long life of all components by means of optimum heat distribution, it prevents deterioration of the excellent colour rendering property of the phosphor.

The high pressure quartz discharge tube is mounted by an exclusive system that defeats vibration and wastage of light, and reduces the number of working parts.

This mechanically made discharge tube is sealed in nitrogen and is filled with argon and mercury. Special features of its construction are twin auxiliary electrodes on ratings above 250 watts to ensure reliable ignition even at temperatures as low as −40°C.

An exclusive feature is a new capping process, which screws the glass into the cap without cement.

* No voltage grades—all lamps suitable for 200/250 volts. Stock problems eliminated!
* Universal burning position.
* Largest range—50 to 1000 watts through seven ratings.
* Unique Isothermal shape ensures long life and colour maintenance.
* 250-400 & 700 watt have mechanical caps. No cement means no loose caps—ever!
* Mechanical manufacture of all components ensures extreme reliability and quality constancy.

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INDUSTRIAL NEWS AND INFORMATION . . .

FIVE manufacturers of earth moving equipment recently gave a three-day demonstration of the machines which they make, or for which they have the selling agency, at Clockhouse Lane, near Staines. A number of interesting tractors, shovels and bulldozers were shown working in very well simulated site conditions of great severity.

Examples of the Fiat range were shown by the organizers, Mackay Industrial Equipment Ltd., who are agents for these manufacturers and a number of others; Allis-Chalmers, Aveling-Barford, Morewear, Road Machines (Drayton). Wacker and Eimco equipment was also on display. Demonstrations were carried out on all three days and the machines were put through their paces extensively. Unfortunately, we are not able to include details of all the plant shown owing to lack of space, but the specifications or brief descriptions of a few are included below.

The Fiat FL4 Tractor Shovel.

Morewear Tractor Drawn Dumper

To fill the gap between the tipping truck and the specialized earthmover, R. Smith (Horley) Ltd. are manufacturing the Morewear goose-necked dumper. This system of transport, which employs a Fordson tractor as the motive unit, is suitable for use in earth-moving and road building, general haulage, sand and stone mining, and forestry and agricultural work.

The Morewear dumper consists basically of a tipping body carried on a two-wheeled trailer, which is coupled to the tractor by a fabricated goose-neck extension. The actual connection between tractor and trailer is a feature of the design, being a quick-release spherical coupling. The trailer can be detached quickly, so that one tractor can handle several trailers or be taken off for other duties. To take further advantage of this quick-release feature there is a telescopic hydraulic jack built into the base of the goose-neck. Whilst the dumper is in use this is completely retracted inside the goose-neck, but when the dumper is to be uncoupled the jack is lowered by the operation of a hand lever, and a wide-based foot supports the front. The goose-neck coupling on the tractor is beneath the driver's seat and its effective load is transferred to the tractor 3½ in. (8.9 cm.) ahead of the rear wheel centres. The weight of the load and dumper is partially transferred to the rear wheels of the tractor to increase traction, but an additional weight of 700 lb. (317 kg.) is supplied as standard equipment for bolting to the front of the tractor cross-member. The dimensions of the goose-neck are such that on acute turns it clears the tractor mudguards, allowing articulation over 90° each side and providing exceptional manoeuvrability. The dumper body is designed to carry 7½ tons (7.620 kg.) or 5-6 cu. yd. of material. The floor is of mild steel plate ¼ in. thick and the sides and headboard of $\frac{3}{16}$ in. plate. The sides and floor are reinforced with welded, box section members. The high tensile steel axle is fitted with 11.00-20, 14-ply tyres with a large ground surface area to provide high flotation. Brake drums are of 15 in. diameter and cable-operated brakes are standard, with vacuum or air brakes and larger tyres as optional extras.

T.E.C. 170 for further details

The Morewear Dumper.

Fiat FL4 Tractor Shovel

This is a small capacity shovel of which the main details are given below.

Engine: Fiat four cylinder, four stroke diesel, developing 40 b.h.p. at a rated 2,300 r.p.m. Compression ratio 21.5:1.

Transmission: Four forward and four reverse speeds are available through a single plate, over-centre engine clutch. Steering clutches, one for each track, are of the spring loaded, multi-plate type.

Hydraulic system: A front mounted pump, delivering 11 gallons per minute, has a relief valve operating pressure of 1,700 p.s.i. Rams for bucket, tipper and bucket lift are 3 in. in diameter and the total capacity of the hydraulic system is 6.4 gallons.

Bucket: The capacity of the bucket is ¾ cu. yd. with a 4 ft. 7 in. cutting edge. Maximum break-out force is 5,300 lb. and the lifting capacity is 2,200 lb. to the maximum discharge height of 7 ft. 3⅜ in. to the cutting edge.

T.E.C. 171 for further details

Improved Calfdozer

A number of changes in the specification of the well known Aveling-Barford Calfdozer give an even better performance. The engine is now a 12 b.h.p. industrial type diesel with a four stroke cycle. Power is transmitted to each track separately, through independent gear boxes and clutch assemblies. This transmission ensures full traction whilst turning and, since each track can be individually driven either forwards or in reverse, extreme manoeuvrability is obtainable. The blade is carried on a tubular arm pivotally mounted near the centre of the frame, thereby distributing the thrust evenly over all the track shoes in contact with the ground, at the same time maintaining good balance. The blade is raised or lowered by hydraulic hoist and can be held at any height. All parts needing protection are enclosed, but readily available for lubrication by grease gun, and seals are fitted to the bearings of the track rollers and idlers.

T.E.C. 172 for further details

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A.P.124

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The Ammann 'Standard' Paver

The 'Standard' paver is a logical development from the well-known original mobile machine, but it has an increased output and many advanced features.

The laying width is readily adjustable from 6 ft. 9 in. to 10 ft. by a hand operated telescopic mechanism, and a cut-off plate provides infinite variation between 3 ft. and 10 ft. The feed is from an integral hopper equipped with rollers for pushing delivery lorries during discharge. The two twin-tyred towing wheels are power operated by a chain driven hydraulic pump and conversion from the laying to the towing position is only a matter of minutes. The chassis is of electrically welded steel tube and plate construction mounted on tracks. Each track is separately driven through two robustly constructed plate clutches operating from a common shaft. These clutches are extremely sensitive, providing accurate steering for laying and negotiating turns. The patented tamping-screeding beam is situated centrally, between the tracks, which ensures an accurate longitudinal profile, whilst the cross profile is formed by adjustment of the articulated sections of the beam, and is heated by a propane gas cylinder fitted with a gauge and variable control valve. (Two gas cylinders are fitted, one acting as a spare.) The low bearing pressure of the tracks permits surfacing over lightly consolidated foundations. The general versatility of the machine is emphasized even further by the wide range of materials it can lay. These include both hot and cold specifications—even 'Mastic Asphalt' BS.1447 is handled quite effectively—and because of the open feed, lean-mix concrete and dry stone aggregates up to 2½ in. nominal grading can be laid without the need for additional equipment.

T.E.C. 173 for further details

Road Bollard Improvements

In the interests of road safety it was thought by Safety Research Services Ltd. that a marked improvement in the design of bollards for use on pedestrian refuges was long overdue. After several years of intensive research this firm have now developed the design shown in the photograph right. The main advantage of this new bollard is that of visibility; the slender column of the new design does not conceal pedestrians, particularly children, who might step out into the road without warning. The bollard also has a certain amount of back illumination to counteract any disguising of movement behind the light source.

This bollard consists of a tubular metal framework enclosed in a tough non-inflammable spun polythene case, which houses the electrical components and is completely waterproof. The polythene tube affords a brilliant all-round amber illumination from a 12 in. fluorescent light incorporated in the stem. The bollard head, which is also a directional KEEP LEFT sign, is fabricated of perspex and fibreglass laminates illuminated by a 9 in. fluorescent tube. The fibreglass ensures uniform light both forwards and backwards. The head is bolted to the tubular metal framework and sealed by a polythene collar. All parts of the bollard head are of plastic welded construction to ensure that it is weatherproof and cannot be tampered with by unauthorized persons. The metal framework is internally inserted into a metal pipe which is concreted into the bollard site.

On installation the bollard is positioned so that 4-5 in. of base tube is showing below the polythene case. For access to electrical fittings a lock nut is removed and the polythene tube dropped 4-5 in. to the bollard base. The head of the bollard can then be removed and complete access to all parts is possible.

T.E.C. 174 for further details

The new design for road bollards produced by Safety Research Services Ltd.

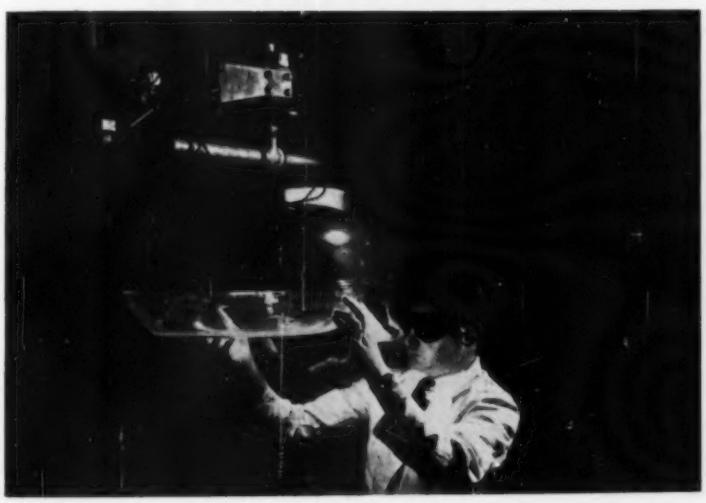
Reorganization at GEC

The General Electric Co. Ltd., which has been carrying out a decentralizing reorganization within the last year or so, has decided to extend the process to its research laboratories, with the aim of relating applied research more closely to commercial development. They are to set up autonomous research units, operating side by side, to enable those of the commercial groups and subsidiary companies of the GEC to have research units under their own control. To mark this fundamental change in policy, the laboratories are to be renamed the Hirst Research Centre, as a tribute to the company's founder, the late Lord Hirst.

The function of the units will be to co-operate with their associated group to ensure that developments shown to be economically viable can be commercially exploited in the shortest time and bring returns on the research expenditure reasonably quickly. To ensure that long-term research continues to be undertaken, GEC are also establishing two main research units. One is the Central Research Laboratories, which will be responsible for most of the more fundamental programmes for the company as a whole and the groups or subsidiaries. They will also provide specialized scientific and technical services and advice to ensure effective scientific liaison between all units. The other department is the Telecommunications and Engineering Research Laboratories, which will carry out work for the telecommunications and engineering groups and undertake long-term research in related fields.

The outward effect of these changes will not be felt for some time with the result that lighting and lamp research will retain its familiar character for the present.

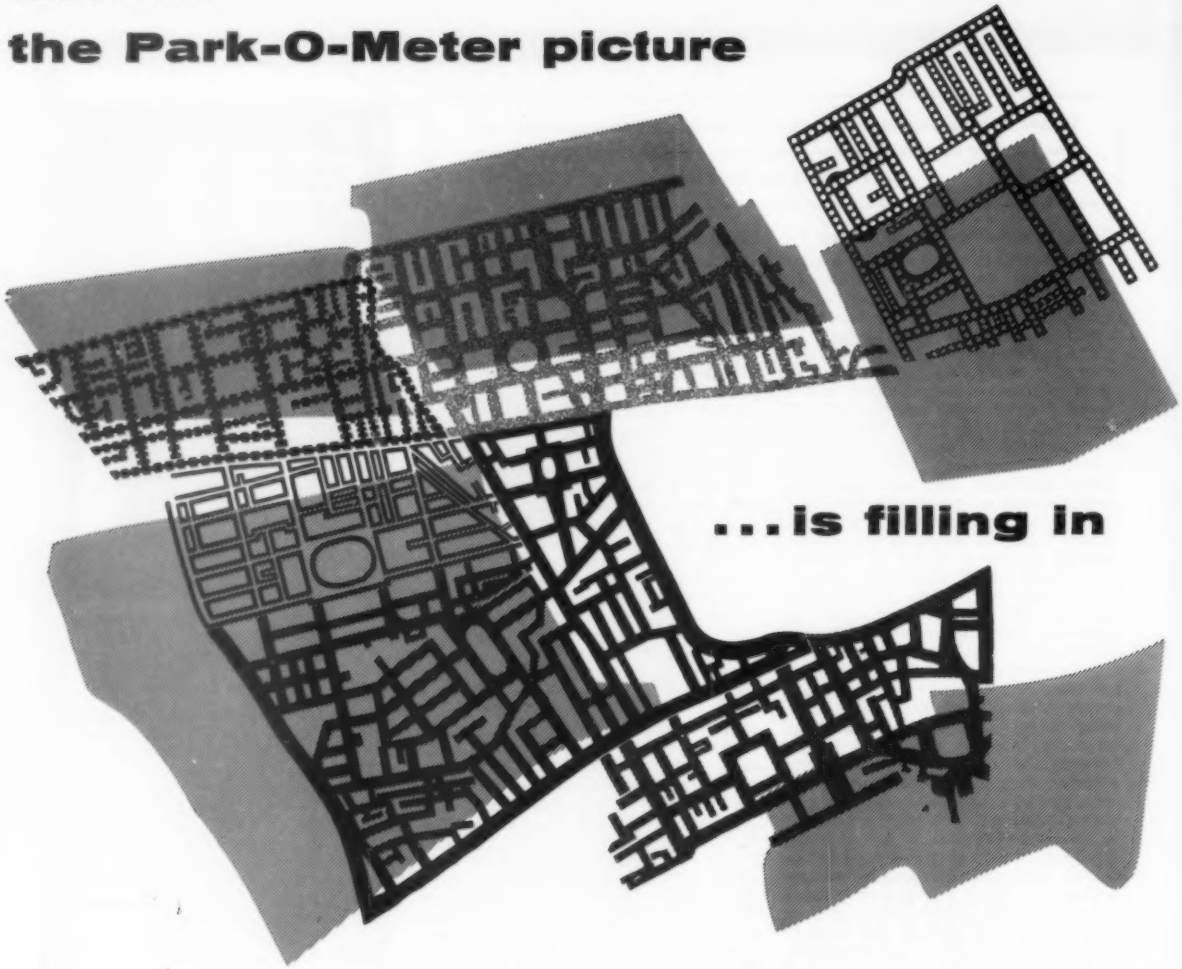
T.E.C. 175 for further details



Street lighting developments. Research in progress in the G.E.C. laboratories.

TEC359 *for further information*

the Park-O-Meter picture



The success of these pioneer schemes is a clear pointer to the future.

- City of Westminster. 625 Park-O-Meters in operation since July 1958.
- Borough of St. Marylebone. 466 Park-O-Meters in operation since June 1959.
- City of Westminster. 1,209 Park-O-Meters in operation since April 1960.
- Borough of Holborn. 670 Park-O-Meters in operation since October 1960.
- City of Westminster. 806 Park-O-Meters in operation since November 1960.
- Borough of St. Marylebone. 726 Park-O-Meters in operation since November 1960.

By the end of 1960, the total number of Venner Park-O-Meters in London exceeded 4,500. Already, the three most recent installations are making a useful contribution towards speeding the flow of traffic, and will greatly augment the funds available for off-street parking developments.

VENNER

PARK-O-METERS

The phrase "Park-O-Meter" is a Trade Mark of Venner Limited.

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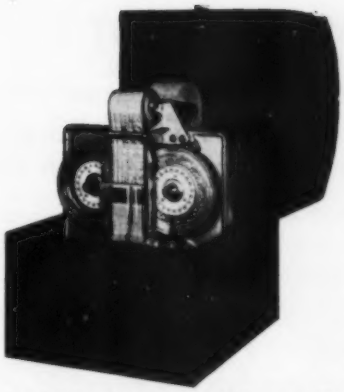


The Fischer & Porter punched tape traffic counter, which was described in the February issue of Traffic Engineering & Control.

T.E.C. 176 for further details

Time Saving on Site

The consortium of Cubitts, Fitzpatrick and Shand, who are at present engaged on the Hyde Park—Marble Arch road scheme, are extensive users of radiotelephone equipment. It was during the making of the Doncaster By-Pass that the Pye system first proved its value and they are using the same system at the new site.

The construction of the By-Pass included the removal of obstructions, the making of new watercourses, filling in culverts, bridge building, surfacing and levelling off. The prearranged schedule had to be maintained and time was a very important factor. Unavoidable snags occurred, but delays were reduced to a minimum. For example, if a tractor broke down, the breakdown service was immediately directed there by radio, obviating the danger of work being held up at other points along the road; or again, if more men were required at a particular place, the radio brought help from the nearest gang; if more material was needed, the foreman, in constant radio contact had the deficiency remedied with no waste of time.

The Cubitts-Fitzpatrick-Shand headquarters were set up at Warmsworth in Yorkshire, where a 60 ft. aerial mast surmounted the radio control room and by arrangement with the Duty Operator the administrative staff could communicate with any of the outside supervisors. In addition, three of the senior staff had Pye remote control units on their desks so they could speak directly to the outstations. Mobile works offices, fitted with Pye Ranger radiotelephones were stationed alongside bridges, culverts and at special construction points. Various Jeeps, heavy transport, works vehicles and the Rolls Bentley belonging to Mr. Shand were also equipped with two-way radio. So obvious were the advantages of this radio link-up in the greater utilization of equipment and manpower, that even the sub-contractors had Pye units installed in their vehicles and these worked into the main control room.

T.E.C. 177 for further details

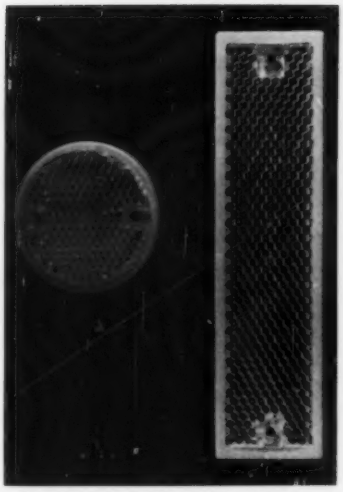
Rubberized Road Paints

If road marking coatings are to be maintained in a clean and visible condition, they usually require renewal on very busy roads at approximately six-monthly intervals. The cost of material in relation to the mileage to be maintained is not inconsiderable and, when the cost of labour employed in its application is included, the total expense of marking roads is a substantial addition to their overall maintenance costs. After studying this problem for some time, British Paint Laboratories have succeeded in formulating a coating which they claim gives a longer working life and a consequent reduction in cost.

The new paint, to be known as Super Guideline, is a synthetic rubber based material and will be available in two qualities—brushing quality, formula reference MS 1164, and spraying quality, formula reference MS 1186. It is important to note that the brushing quality is quite unsuitable for use in road line spraying because of its tendency to cobweb, but if necessary the spraying quality can be used for brush application. Both paints are suitable for use on all types of road surface. To give an accurate forecast of the spreading rate or drying time of these paints is almost impossible, but the manufacturers state that on a fair, smooth surface an area of approximately 45 sq. yd. can be covered by one gallon, or 405 linear yards of 4 in. line. According to the atmospheric conditions at the time of application, the paint should be touch dry in five to eight minutes and dry to the point of no pick-up in 10 to 15 minutes, after which it will accept normal traffic—providing no sharp braking or skidding occurs across the actual paint. Where newly applied lines are concerned, it may be necessary to apply two coats, in which case a period of two hours should elapse between each.

Super Guideline is available in three colours, white, black, and yellow. Tests have shown that its wearing qualities are very good indeed, and its ability to retain Ballotini type beads is excellent.

T.E.C. 178 for further details



The two types of Fairylite reflector.

All Plastic Reflectors

Fairylites Ltd. are the manufacturers of a new type of rectangular prismatic reflector made entirely from plastics and giving an increased area of reflection. One advantage of this type of reflector is that, as it is a completely sealed unit, the reflective prisms are entirely protected and should have an almost unlimited life. Being manufactured only in plastic materials, no maintenance is required, as neither rusting nor corrosion can occur. The units are lightweight, watertight, dustproof and petrol resistant and are unaffected by weathering or extremes in temperature. These reflectors have many applications such as road posts, warning signs, road obstruction markings and danger points, level crossing gates and gate posts and width markers for bridges—and they are available as standard red or clear reflectors mounted in a white case: other colours can be supplied to order subject to minimum quantities.

T.E.C. 179 for further details

A Pye radiotelephone in operation.

Duopark Twin Automatic Parking Meter

Latest short-term kerb parking control

Arrows clearly indicate each parking space and coin-slot

Broad red flags—clear visibility—rapid mobile or foot-patrol check

One clock—one weekly winding—one coinbox serves both spaces

Use one meter on one post to control two cars—posts 40 ft. apart

Really secure coinbox and on-site collection system

Suitable for all climatic conditions

All mechanisms interchangeable—on-site replacement without tools

Vibrations will not affect timing

Instant operation on insertion of coin—last coin in view

Neat sturdily built mechanism—pressure die-cast housing

Greater turnover at kerb and greater earnings towards off-street parking programmes

Do not invite excess-time parking—it defeats metered control. Install the Duopark Twin cancelling type meter as used in many countries.

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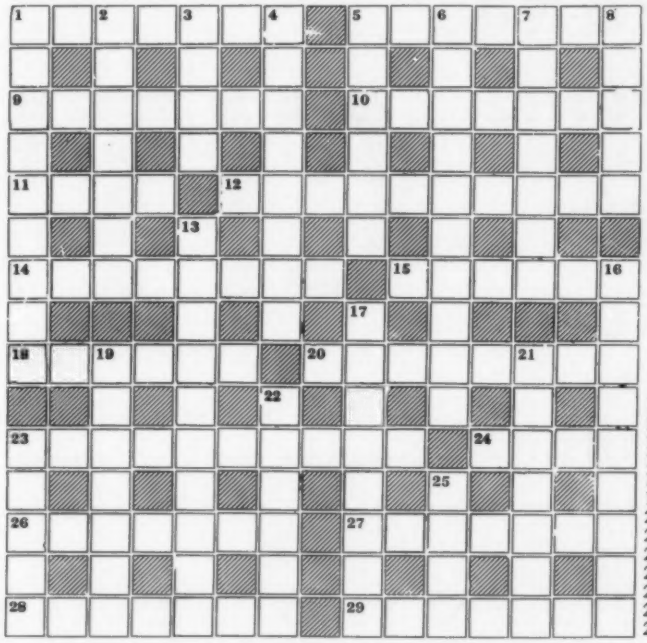
Specialists in the application of Plastic White Lines for the last 18 years, Constructex Ltd. offer applications by automatic machines in addition to the manual and hand-propelled machine methods. Quotations will be provided on request for the marking of roads, car parks, school playgrounds, factory yards, etc., or for the supply of material and equipment.

TRAFFIC ENGINEERING CROSSWORD NO. 9 by YEO

AMONG the clues and solutions will be found traffic engineering terms defined in the VOCABULARY OF TRAFFIC ENGINEERING TERMS published for *Traffic Engineering & Control* by Printerhall Ltd., and a copy of which is sent free to all subscribers to this journal. Copies are also available at 2s. 6d., post free, from the Circulation Manager, Traffic Engineering & Control, 34/40 Ludgate Hill, London, E.C.4.



SOLUTION TO CROSSWORD NO. 8

V	I	C	E	N	Z	A	■	S	Y	C	E	S		
E	■	■	A	■	V	■	T	■	A	■	L	■		
H	Y	P	E	R	M	E	T	R	O	P	I	A		
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L	■	T	■	S	■	■	I	■	■	■	■	■		
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■	■	■	E	■	■	G	■	O	■	E	■	■		
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E	■	P	■	I	■	A	■	A	■	■	■	A		
R	E	S	I	N	■	P	A	R	K	W	A	Y		

Across

1. A tuft of woolly hair. (7)
5. Fruit maturity but not horsefeathers. (7)
9. Is it game? (7)
10. Back, gammon? (7)
11. This tide perhaps does not lead on to fortune. (4)
12. Rootes' wall charts? (10)
14. Only owing duty to the Crown. (8)
15. Release for a type of road. (6)
18. To oppose an upset sister. (6)
20. Beard. (8)
23. Controls traffic from one direction. (6, 4)
24. Close to being mean. (4)
26. Not O.K. but K.O. perhaps. (7)
27. Sounds as if Baba intended to eat. (7)
28. The part used by vehicles. (7)
29. Ants hesitate before the entrance. (7)

Down

1. 'What though my winged hours of bliss have been,
   Like angel visits, --- --- --- between?'
   (Campbell). (3, 3, 3)
2. Sort of road that is queer and lonely in Scotland. (3, 4)
3. To starve is known to socialists. (4)
4. Vicelike? (8)
5. Could be an all-red or a clearance one. (6)
6. Not even an X. (10)
7. In the theatre the twenty first letter ends the swan lady rising. (7)
8. Alleviates. (5)
13. Self-confessed murderer. (3, 7)
16. Percolates by grace of the Road Traffic Acts. (9)
17. To get narrower but not on a road. (8)
19. Put your name to nothing artist lady. (7)
21. It would be cold round the waist. (3, 4)
22. A very loud beam causes disturbance. (6)
23. Got fares muddled up. (5)
25. Type of road missing the jam. (4)

TRAFFIC ENGINEERING COURSE

THE new Lancaster College of Technology at Coventry is providing a short Traffic Engineering Course of eight lectures from March 16 to May 18, 1961, as follows:

March 16 **Instrumentation and Measurement of Traffic Behaviour.** DR. T. E. H. WILLIAMS, B.SC., PH.D., A.M.I.C.E., A.M.I.STRUCT.E., F.S.S., King's College, University of Durham.

March 23 **Traffic Flow Calculations.** A. J. H. CLAYTON, B.SC.(ENG.), A.M.I.C.E., Chief Engineer's Department, London County Council.

April 13. **The Design of Road Junctions.** K. SUMMERFIELD, M.SC., M.I.C.E., County Surveyor, Oxfordshire County Council.

April 20. **The Interaction of Road Construction and Traffic Problems.** H. E. WALKER, M.ENG., A.M.I.C.E., A.M.I.MUN.E., Head of the Department of Civil Engineering and Building Lanchester College of Technology, Coventry.

April 27. **Street Lighting, Road Signs and Miscellaneous Problems.** A. W. CHRISTIE, M.A., B.SC., Road Research Laboratory.

May 4. **Car Parking and Related Problems.** B. SCHLAFFENBERG, DR. ARCH., A.M.T.P.I., University College, London.

May 11. **The American Approach to Traffic Engineering.** J. M. LOVEDAY, B.ENG., City Engineer's Department, Birmingham Corporation.

May 18. **Coventry's Road Problems and Their Solution.** GRANVILLE BERRY, M.I.C.E., M.I.MUN.E., City Engineer and Surveyor, Coventry.

Supplementing the Course is a public lecture sponsored jointly by the Coventry Productivity Association and the Lancaster College of Technology on March 8, when Mr. J. C. Wardrop of the Road Research Laboratory is to give a paper on 'The Contribution of Traffic Engineering to the Solution of the Road Problem'.

Mr. Granville Berry, City Engineer and Surveyor of Coventry, is the Chairman of the Building and Civil Engineering Advisory Committee of the College.

University of Reading

The University of Reading is organizing a Town and Country Planning Summer School from September 6 to 13, 1961, with an overseas section meeting from September 12 to 16. Among the papers to be given are:

Problems of Urban Development. Eric Lyons, O.B.E., F.R.I.B.A., M.S.I.A.

The Future of Conurbations. Professor P. Sargent Florence, C.B.E., M.A., PH.D.

The Changing Landscape. Professor H. C. Darby, O.B.E., PH.D., D.LITT.

The Hook Project and other Research for Town Development. J. C. Craig, A.R.I.C.S., A.M.T.P.I., Head of Town Development Division, London County Council.

Planning Legislation—An International Review. Desmond Heap, LL.M., P.P.T.P.I. (*Joint Session with the Overseas Section*).

Traffic Engineering is to be one of the subjects to be taken by the Discussion Groups.

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